Concrete

Vol. 37 Chicago, November, 1930 No. 5

Concrete Pits of Bascule Bridge Resist High Water Pressure

Machinery Pits Under 25-Foot Pressure Head—Watertightness the Most Important Requirement—Caisson Supports Carried to Bed Rock—Special Cement in Pit Concreted During Cold Weather—City's Bridge Division Maintains Inspection

CONCRETE that resists a pressure head of 25 feet of water may be seen in the walls and floors of the machinery pits at both abutments of the double leaf trunnion bascule bridge now under construction over the main branch of the Chicago River at Wabash Avenue, Chicago.

Figure 1 is a view of the north pit, from a photograph taken soon after its completion and before any part of the machinery or the superstructure had been placed. Both pits remained thoroughly dry after all protecting sheet piling was removed, indicating that the concrete is of as high a quality as its clean-cut appearance suggests.

Layout and Profile of Bridge

The general layout of the Wabash Avenue bridge is shown in Figure 2. As here shown the pits comprise the space formed by the four walls of the abutments. The floor of each pit is a concrete slab 5 ft. thick and the entire structure acts as a unit supported on concrete sub-piers or caissons.

Sub-piers or Caissons

The number, size and location of the concrete sub-piers or caissons are shown in Figures 2 and 3. From these drawings it will be seen that the north pit is supported on nine sub-piers of the various diameters shown in the upper part of Figure 2, and the south pit is supported on seven sub-piers of the various sizes indicated.

In Figure 2 the sub-piers are shown carried down to an elevation of 75 ft. below datum, the base of each pier

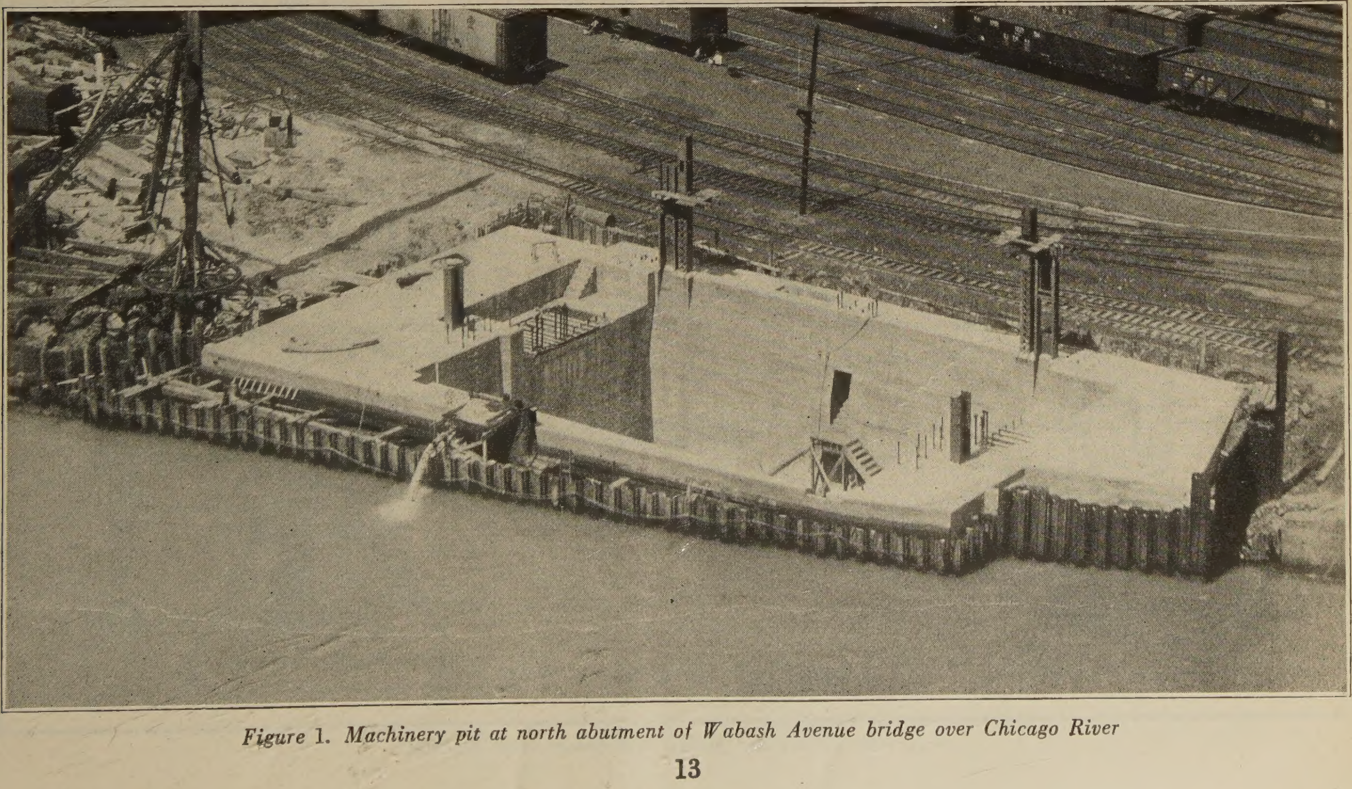

Figure 1. Machinery pit at north abutment of Wabash Avenue bridge over Chicago River

being shown belled out. The specifications permitted omission of the bells wherever the caissons were carried down to bed rock. As actually built, all caissons (under both pits) were founded on bed rock, at an average of 103 ft. below datum, so that no bells were required.

Dry excavation was encountered at all sub-piers, only an occasional bailing out of water having been necessary. No quicksand was found.

On any individual caisson or sub-pier every effort was made to continue the work without interruption from the time the excavation was started until concreting was completed. In a few instances when the placing of concrete was unavoidably halted the surface was left rough and was then cleaned and covered with a coating of cement mortar before concreting was resumed.

The form work for the sub-piers was of the type com-

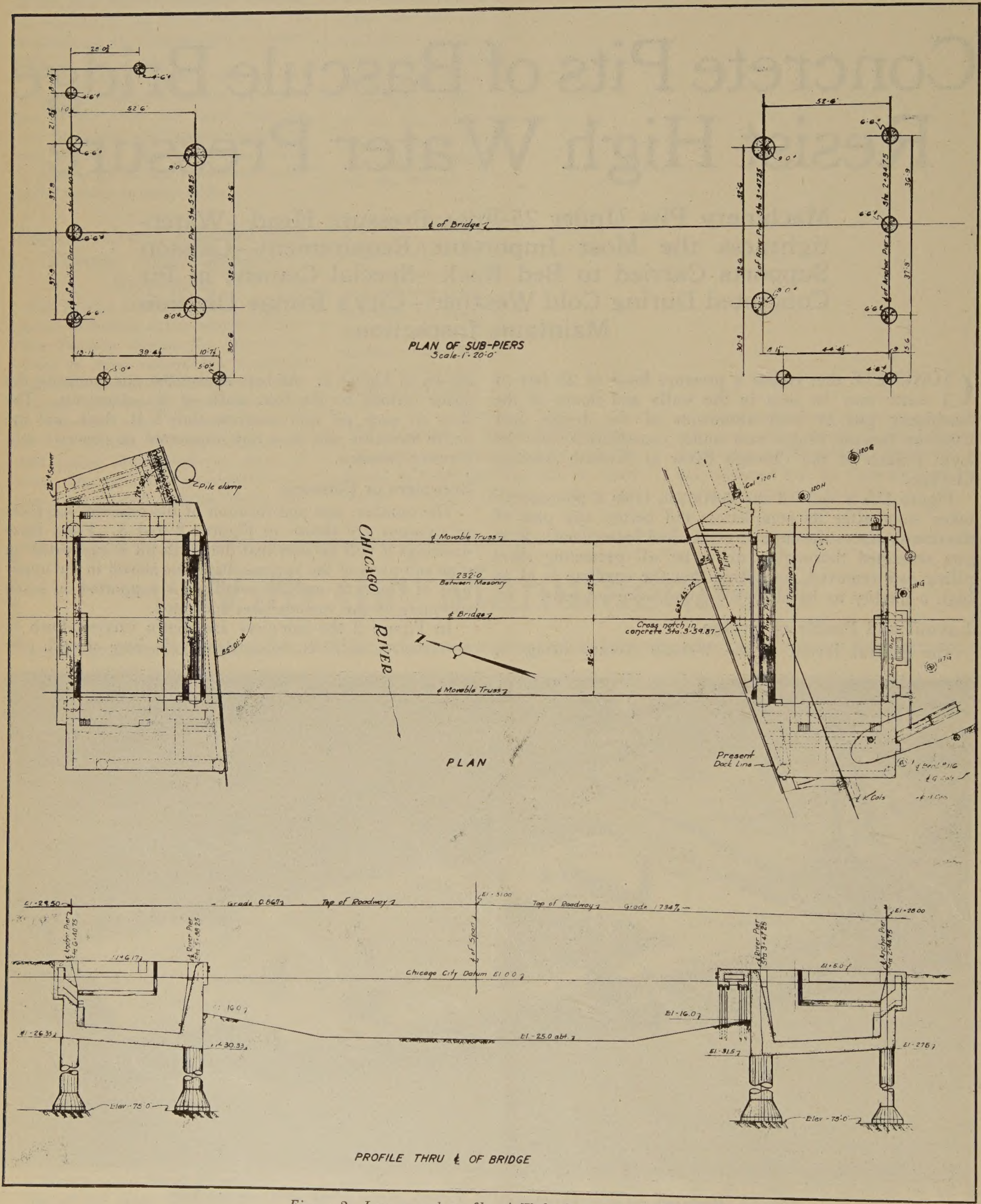

Figure 2. Layout and profile of Wabash Avenue bridge

monly employed in downtown Chicago, namely, 3 in. lagging in lengths of 5 ft. and 4 in. No special difficulties were encountered in the placing of the concrete, which was distributed by means of buggies.

Watertightness the Dominant Requirement

The concrete machinery pits comprise the substructure feature of greatest interest, because of the necessity for absolute watertightness under a high pressure head. The north and south machinery pits combined contain 6,400 cu. yd. of concrete in addition to the concrete in the sub-piers, an amount that seems rather surprising until the massive nature of these structures is realized. Of this total volume of concrete above the sub-piers the north pit contains 3,240 cu. yd.

Precautions in Placing Concrete

Special precautions were observed in placing the concrete. For illustration, the joint between the walls of the pit and the 5 ft. slab comprising the floor was double keyed and the surface was roughened, thereby reducing the probability that water might find its way through this joint, which is under about 25 ft. of water pressure. The concrete in the pit walls was placed in vertical stages varying from 4 ft. at the bottom to 8 ft. at the top. Each stage was concreted without interruption, and the joints between stages were double keyed and roughened in a manner similar to the treatment of the joint between the bottom slab and the walls.

City Bridge Division Maintains Inspection

Careful check on the quality and placing of the concrete was made by engineers representing the city, this work having come under the Division of Bridges of the Bureau of Engineering in the Department of Public Works. This engineering inspection and supervision was carried out under the direction of Loran D. Gayton, city engineer and head of the Bureau of Engineering, and Major Paul Schioler, city bridge engineer and head of the Division of Bridges, which comprises one of the departments in the Bureau of Engineering. Leon B. Kordell is resident engineer of construction on the work, representing the Division of Bridges.

Concrete Materials and Proportions

The fine aggregate was torpedo sand and the coarse aggregate was gravel, ranging in size from 2 in. down in the sub-piers, and 1½ in. down in the pit floor slabs and walls. For the sub-piers and the south machinery pit, standard portland cement was used; but for the north machinery pit, which was the first to be concreted, Super Cement from one of the Marquette mills was used. The concrete in the north pit was placed in the early part of the year, while the weather was still cold, and for that reason it was thought best to use a cement from which a working strength might be expected in a few days, even under adverse weather conditions. This was accomplished, too, with less cement than was used in the south pier, which was concreted during warmer weather.

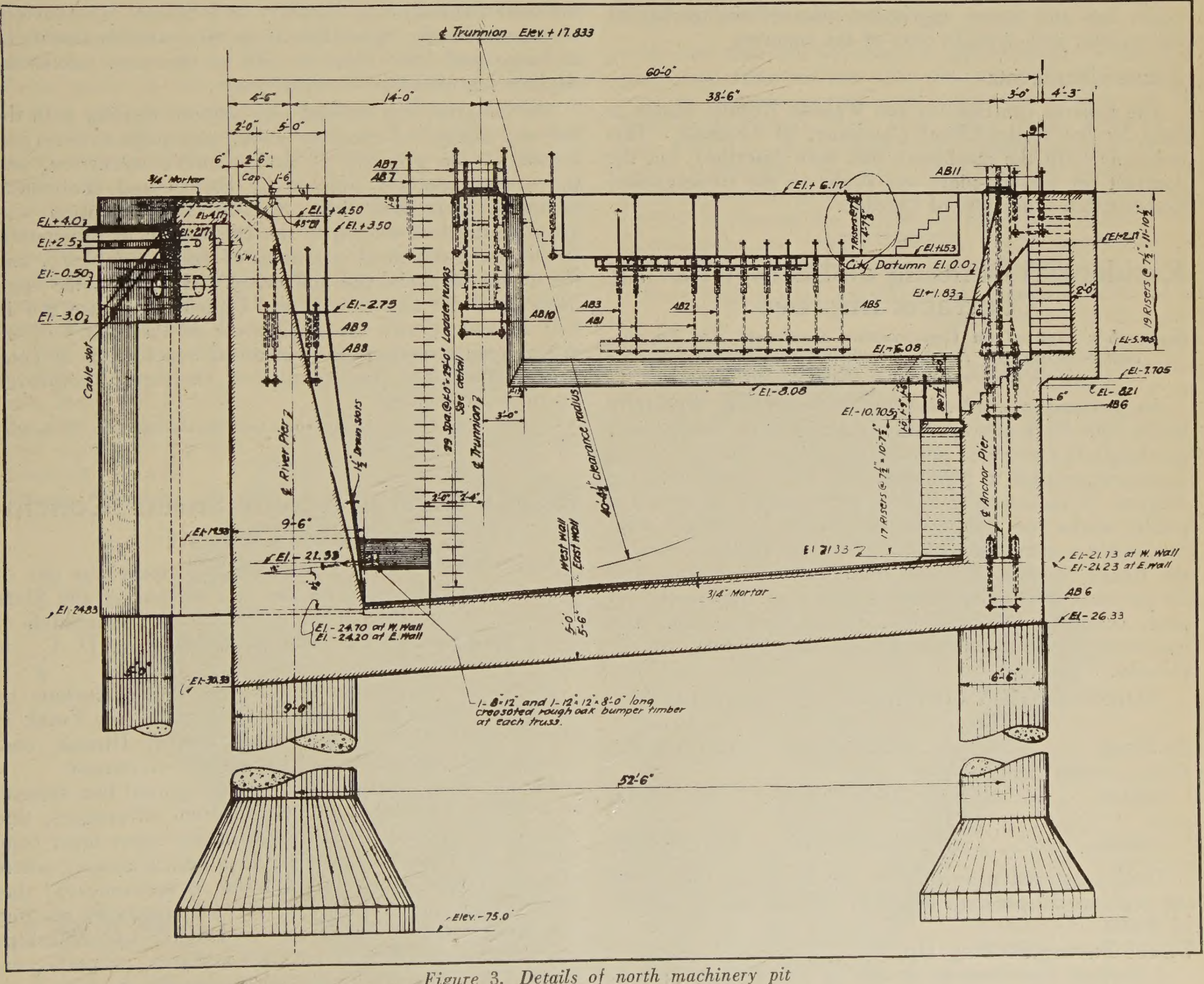

Figure 3. Details of north machinery pit

The proportions in the north machinery pit, where the Super Cement was used, were 1 part of cement, 2.5 parts of torpedo sand and 3.5 parts of gravel, with 6 gals. of water to the sack of cement. This combination had a slump of 4 in. For the south machinery pit and the sub-piers on both sides of the river, in which standard portland cement was used, a somewhat richer mixture was employed, the proportions having been 1 part of cement, 1.7 parts of torpedo sand and 3.2 parts of gravel, with 6 gals. of water to the sack of cement. The slump of this mixture also averaged 4 in., as with the concrete for the north pit.

Concrete Mixing and Distribution

The concrete mixing plants for the two pits were separate installations, because the presence of river navigation made it inadvisable to attempt to deliver concrete across the stream. The mixing plant for the north pit included a Smith ¾-yd. mixer, aggregate measuring hoppers for volume measurement of sand and gravel, and water control equipment.

The concrete was delivered into a hopper and wheeled in buggies to the place of deposit, over runways provided for the purpose. The concrete was carefully puddled in its final position.

Tests and Inspection

As stated previously, the engineers of the Division of Bridges in the Bureau of Engineering maintained careful inspection and supervision over the work. This included a study of the aggregates and the proper proportions between fine and coarse aggregates, tests of the quality of the cement, and strength tests of the concrete.

Acknowledgments

The general contract for the Wabash Avenue bridge is held by the Ketler-Elliott Company, of Chicago. This company built the machinery pits here described, but the contract for the sub-piers was sublet to the Underground Construction Company, of Chicago.

Residential Building and Street Paving Contracts Improve

September Figures on Construction Contracts Are Encouraging—Concrete Roads Continue to Lead—Total Concrete Pavements Well Ahead of Last Year

An increase in residential building contracts, especially in the New York metropolitan area and in the central and northwestern centers of population, brought total building contracts awarded in September to a figure above that for August. A reduction in awards for construction work for public works and public utilities, however, brought total September construction contracts in the 37 states east of the Rocky Mountains 5 per cent below the August and 25 per cent below September, 1929, according to the reports compiled by the F. W. Dodge Corporation. The contracts reported by the Dodge organization are as follows:

CONSTRUCTION CONTRACTS IN SEPTEMBER

	1929	1930
Buildings	$328,173,000	$230,450,700
Public works and public utilities	117,229,300	101,412,800
Totals	$445,402,300	$331,863,500

Total construction awards for the first nine months of the year are 20 per cent below the corresponding months of 1929.

Street Paving Picking Up

A distinct improvement is seen in the pick-up in contracts awarded for concrete street pavements, which approached very closely to the figures for September, 1929. Not since April has the comparison with the corresponding month of 1929 been so favorable. Concrete highway contracts, as in other months, are well ahead of the corresponding month of 1929. The square yards of concrete roads and pavements for which contracts were awarded in September are reported as follows by the Portland Cement Association:

SQ. YD. OF CONCRETE PAVEMENT AWARDED IN SEPTEMBER

	1929	1930
Roads	5,945,015	6,359,756
Streets	3,871,442	3,525,190
Alleys	403,632	195,474
Total	10,220,089	10,080,420

For the first nine months of the year, total concrete pavement awards were 120,973,722 sq. yd., a gain of 6½ per cent over the total of 113,692,489 sq. yd. awarded in the first nine months of 1929.

International Congress on Concrete Held in Belgium

During the first week in September the first International Congress on Concrete and Reinforced Concrete was held at Liege, Belgium, where one section of the International Exhibition of Industry and Science was devoted to concrete work. Specialists from all countries assembled at Liege and contributed to one of the most interesting engineering meetings of recent years.

The congress was divided into sections dealing with the various aspects of concrete work, and papers were presented on the progress of design and construction, and the newest methods adopted by British and continental engineers were described. Considerable attention was given in the first section to the calculation of hyperstatic structures, mechanical solutions of frame problems, and the effects of shrinkage and creep. Although some engineers in Great Britain and the United States are not in full agreement with the application of the theory of indeterminate structures to reinforced concrete, it is noteworthy that rigid frame design is exclusively employed on the continent.

Abstracted from *Concrete and Constructional Engineering*, issue of October, 1930.

Road Congress Adopts Sheets' Conclusions on Cement

The results obtained by the use of cement was one of the subjects that occupied the first section of the Sixth Congress of the Permanent International Commission of Road Congresses, which met at Washington, D. C., on October 6th to 11th.

The section unanimously adopted the conclusions on the use of cement presented, with alterations, by Frank T. Sheets, chief highway engineer, State of Illinois, concerning the results obtained by the use of cement.

Among these conclusions it was recognized that cement, as a paving material, has many inherent advantages; that two-course concrete pavements, with the upper layer composed of very hard aggregates, have been necessary where a large volume of steel-tired traffic is encountered; that construction operations are performed mostly by machinery, with resulting lower cost and better workmanship; and that maintenance of concrete surfaces, properly constructed, is relatively simple and reasonable in cost.

Grade Separation Structures Untangle Traffic Jams

Four Major Types of Grade Separation Structures—Least Expensive Way to Relieve Traffic Congestion—Size of Problem Facing State and County Highway Departments—Unraveling Legal Difficulties in Advance

By ROBERT KINGERY
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THE separation of grades at main highway intersections and at intersections of highways and railways is a problem that must sooner or later be faced and solved by every state highway department, and by a far greater number of county highway departments.

In the less populous or less wealthy states, in which even the primary highway systems are far from being completed, grade separation must of necessity be held in abeyance for the present. Nevertheless, even in those states the highway authorities might well be giving some attention to the question. They might, for instance, take up the task of deciding where future grade separations shall be constructed. They could, with equal wisdom, begin study of the legal difficulties involved, with the view of unraveling some of the legal red-tape in advance, or perhaps devising methods that will simplify the legal phase of grade separation. These matters will be discussed farther on.

Before proceeding further, the writer wishes to express the opinion that so far as thickly populated areas are concerned the construction of grade separations at main highway intersections will do more to relieve traffic congestion than is possible by any other means at anywhere near the same cost.

This opinion is supported not only by common sense, but by traffic data collected several years ago by the Detroit Rapid Transit Commission. The commission's investigations indicated that a single traffic lane has a capacity of 2,000 vehicles per hour when the cars are running at the rate of 20 miles per hour, provided the flow is uninterrupted at intersections. The same traffic lane, given frequent grade intersections, will have a vehicle capacity of less than 600 per hour. This reduced capacity is due not only to the time consumed in standing still, but to loss of time in slowing down and in starting.

Magnitude of the Problem

No one who has not made a special study of highway grade separation realizes fully the magnitude of the problem or the vast expenditures required to solve it. In Westchester County, New York, lying in the environs of New York City, the County Park Commission has carried forward probably the most comprehensive program of grade separation in the United States. In the immediate vicinity of Detroit the Wayne County Highway and Park Commissions are jointly building grade separations at points where park drives cross county highways.

More than a year ago the writer was a member of a committee of seven men, known as the Grade Separation Advisory Committee, which prepared a report covering that part of Cook County, Illinois, lying outside of Chicago.

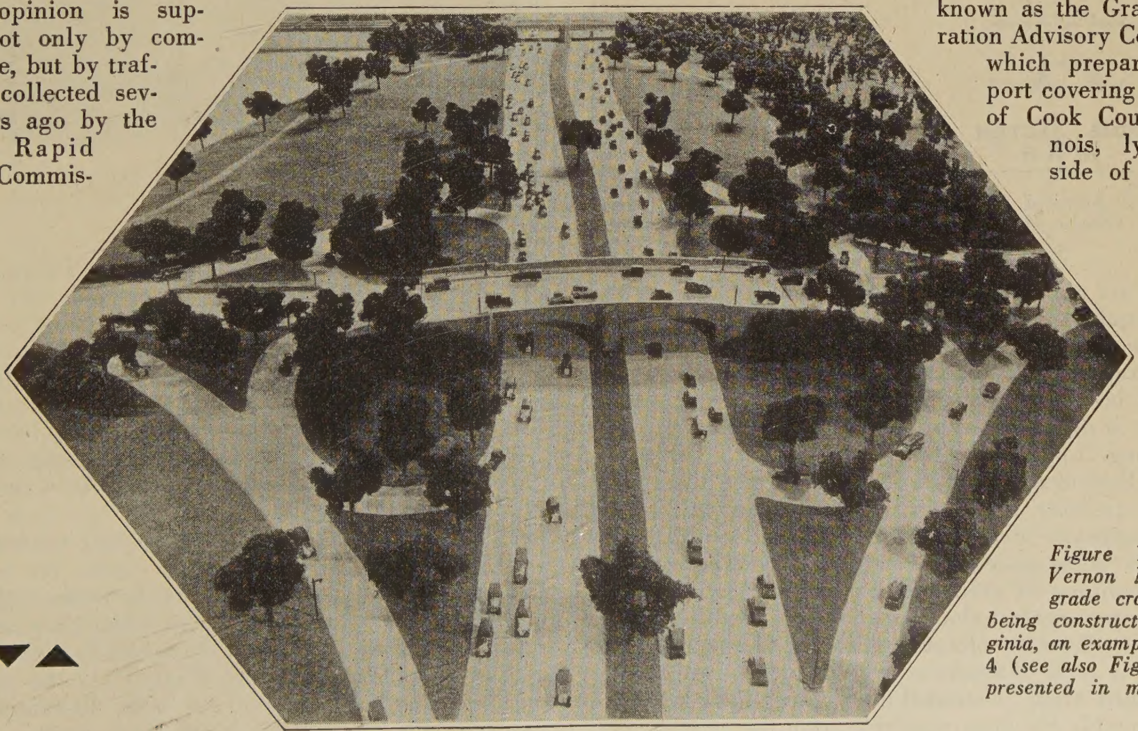

Figure 1. Mount Vernon Memorial grade crossing now being constructed in Virginia, an example of Type 4 (see also Figure 6), as presented in model form

The size of the undertaking that faces Cook County may be visualized from the fact that by the end of 1929 the county had 320 grade intersections of paved highways. It is expected that by 1933 this number will be well above 600 unless some of them are separated in the meantime. As a result, the committee recommended early construction of separations at 38 intersections which were among the most badly congested. The committee further recommended the separation of grades at 95 highway-railway crossings.

A start was made in 1930 on the committee's recommendations. Of the 38 highway grade separations recommended, two have been completed, one is under construction and six are scheduled for early construction as soon as the required rights-of-way are obtained.

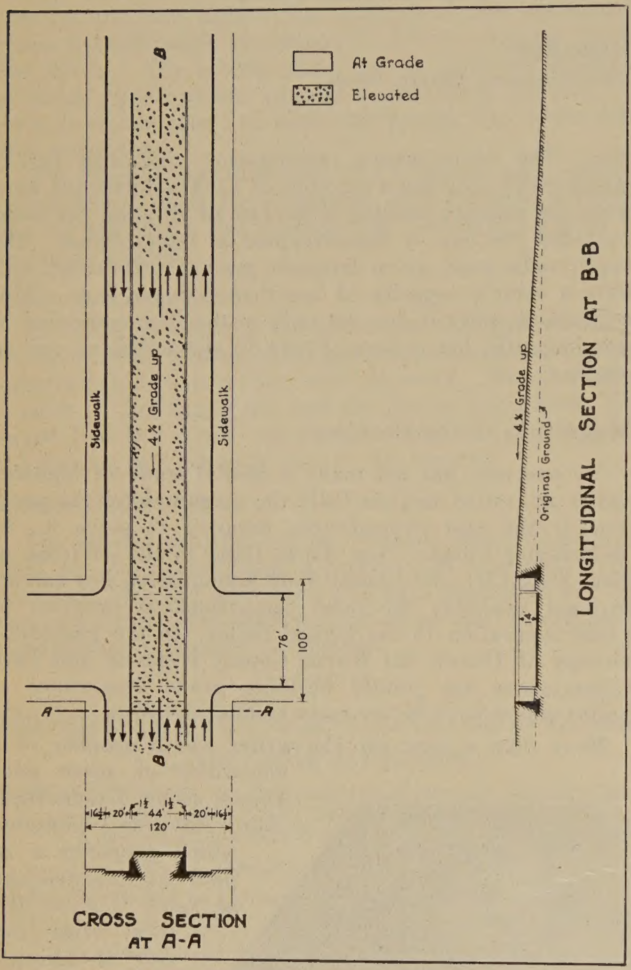

Figure 2. Elevated type of highway grade separation; objectionable because of elevated structure in middle of one street or road

Four major types of structures or plans are employed in the separation of intersecting highways. The first type need not be illustrated, since it is simply a case of two highways at different levels. There are no means provided for turning from one highway to the other. The second type is illustrated in Figure 2. In this case there is an elevated structure which carries the central part of one of the highways over and across the full width of the other, all other pavements and the sidewalks on both roads remaining at grade. This type is objectionable to the property owners along one of the roads or streets because it places an elevated structure in the middle of the street in front of them.

The third type, illustrated in Figures 3, 4 and 5, is unquestionably the most desirable from the standpoint of abutting property owners. This is not in the least surprising, for this type has a far better appearance than the second, or elevated, type. The central part of one highway is depressed, all other pavements and the sidewalks remaining at grade.

Figures 1 and 6 illustrate the fourth type, well suited to crossings where public property is available, and especially when the crossing and the immediate vicinity can be landscaped. Here one of the highways is partly depressed and the other is partly elevated. The diagonal lanes serve as the connecting links between the highways. The manner in which this arrangement operates may be seen by a reference to Figure 6. A driver coming from the north and wishing to turn west simply turns half right as he comes to the first diagonal, and again when he comes to the east-and-west road. However, a driver coming from the south and wishing to turn west is expected to drive past the crossing, to the farthest diagonal, then make a sharp 135-degree turn to the right, and a similar turn to the right when he reaches the main east-and-west roads. Figure 1 illustrates a more elaborate development of the same principle. The authorized routing must be clearly marked, so that drivers will not make the mistake of making left turns. All turns must be to the right.

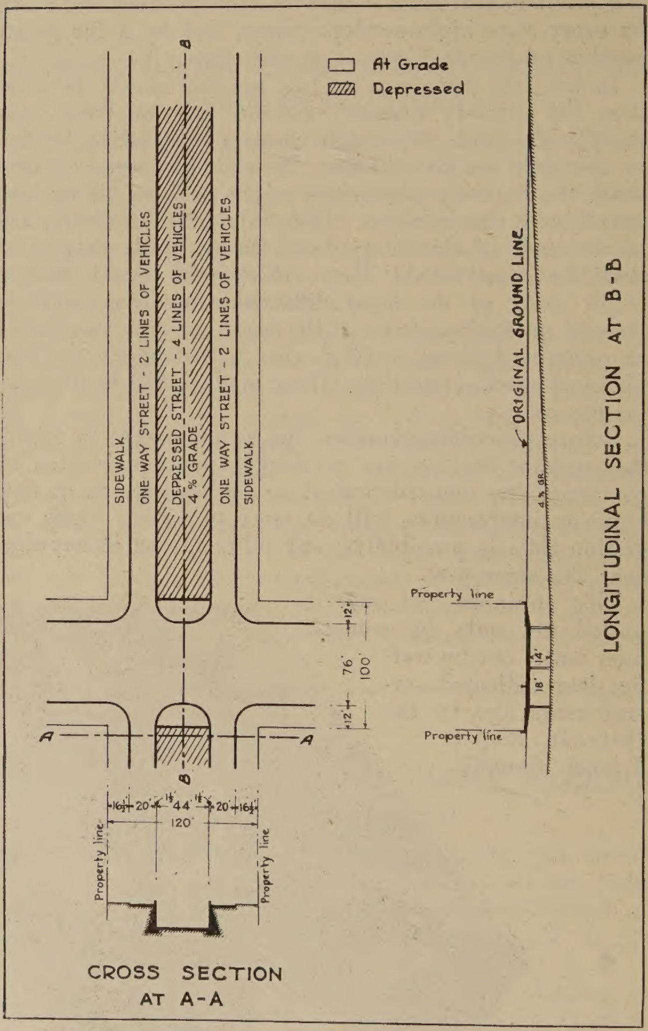

Figure 3. Depressed type of separation; not objectionable to abutting property owners and most desirable in appearance

Another device or arrangement which does not involve actual separation of grades, but which is rather effective, is known as the traffic circle (Figure 7). Its principle is that it keeps traffic moving in both directions on both roads, although the traffic on the circle itself is all in one direction, moving counter-clockwise. A driver coming from any direction swings to the right and into the traffic flow around the circle, and keeps on going around until he comes to the road where he wants to turn off. Thus a driver coming from the north and wishing to turn east first swings to the right into the traffic circle and continues three-quarters of the way around before turning east. While this circle slows down the traffic a little, it has this advantage, namely, that it keeps traffic moving at all times and in both directions, on each of the intersecting roads.

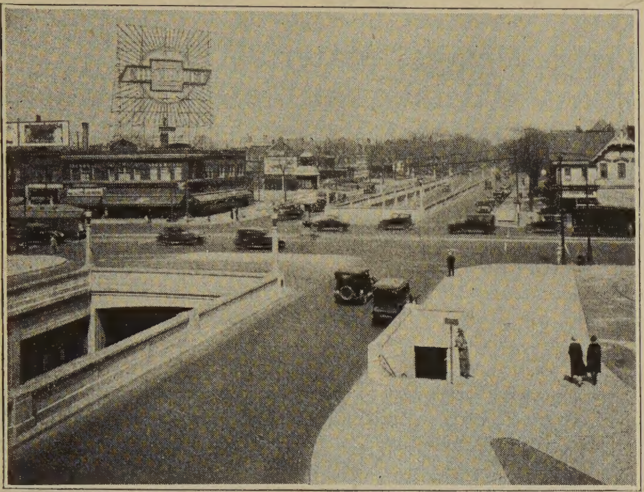

Figure 4. Highway grade separation in Detroit, looking north in Grand Boulevard across Jefferson Avenue. This type is recommended as the most practicable. See also Figures 3 and 5

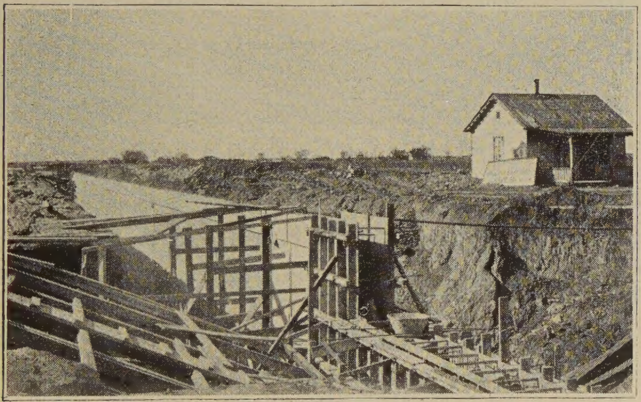

Figure 5. The Dempster Road-Milwaukee Road crossing in Cook County, Illinois, under construction. Similar to Figures 3 and 4

The suggestion was made, earlier in this article, that highway officials in states or counties not yet in a financial position to build grade separations would do well to prepare the way for such construction when it can be done.

First, the matter of deciding where future grade separations are to be located is extremely important. Such a decision can not be made intelligently except as part of a well-considered plan. This plan should be developed by some local committee or commission whose membership includes highway and traffic officials of the state, the county and the city, as well as a few outstanding private citizens.

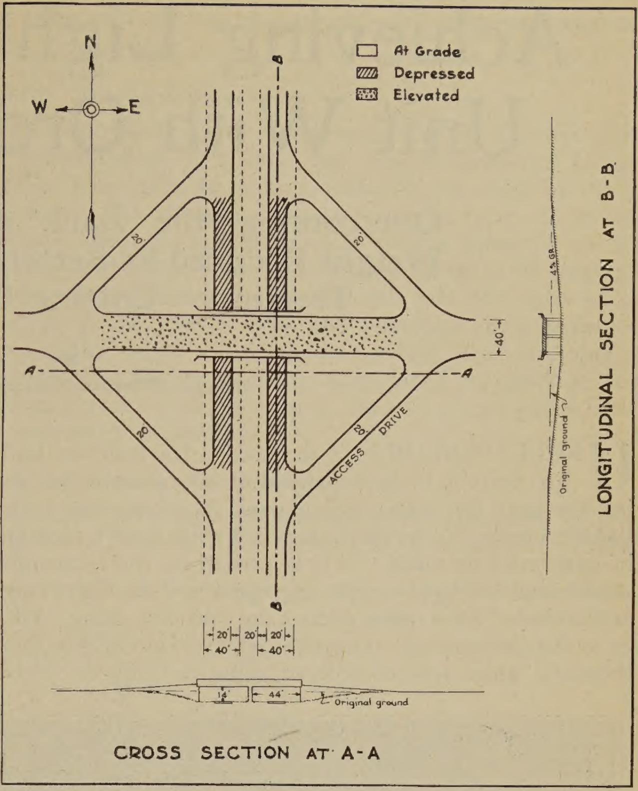

Figure 6. The park type of crossing; a desirable type where public land is available, or where land may be obtained at reasonable price

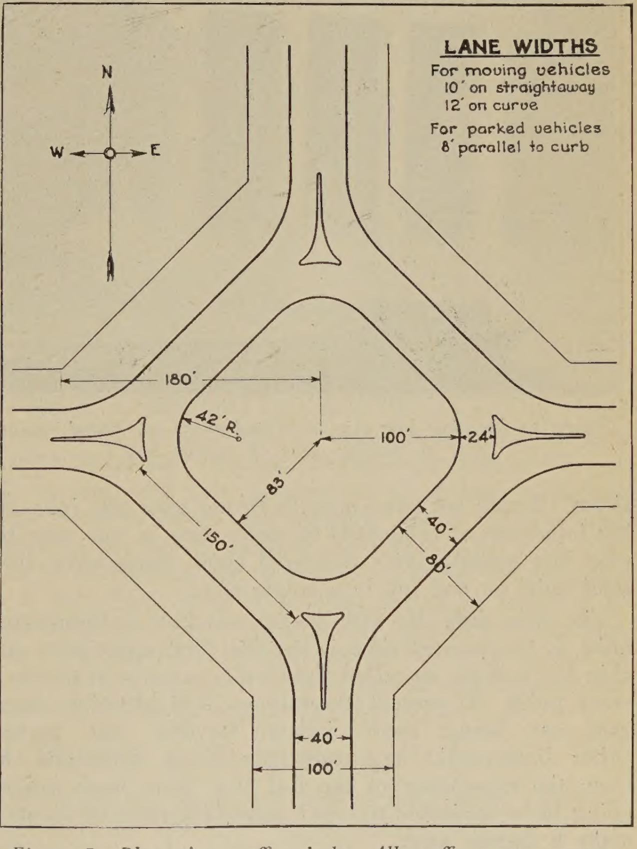

Figure 7. Plan of a traffic circle. All traffic moves counter-clockwise around the circle

The legal matters to which previous reference was made will not be discussed here in detail, because the procedure will necessarily differ in the various states. The first step comprises action by the county commissioners or other local authority, to the end that subdivision platting be controlled so as to provide dedication of adequate land areas for future grade separations at intersecting highways. The second legal step, by the same authorities, involves the establishment of building lines at intersections already subdivided.

Achieving Light-Weight Building Unit With Ordinary Aggregate

Overcoming the Lack of Light-Weight Materials—Weight Reduced by Better Design—Widening the Market Territory—Cutting Corners Instead of Prices

By D. R. COLLINS
Manager, Milwaukee Concrete Products Co-Operative Association

UNQUESTIONABLY, if the market for concrete building units is to be expanded to any great extent during the next five years this expansion must come with a lighter weight, more easily handled unit than is common in most markets today. This is proved by the tremendous strides that the light-weight aggregate and the light-weight unit industry have taken during the past five years. All of us in the industry can remember when a sale of five to ten thousand units was considered quite a thing to "crow" about. Today we have manufacturers who sell jobs taking hundreds of thousands of units, and in one case last year one manufacturer delivered some thirty-seven thousand units on one job in a single day.

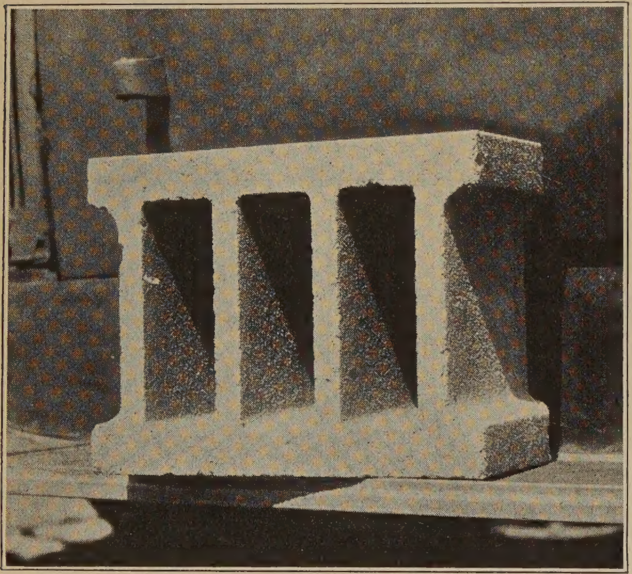

Figure 1. Showing how thin webs and shells are flared out at top, to increase area of mortar bed

The main difficulty with the manufacture of light-weight units at the present time is the fact that aggregates suitable for making so-called light units are not available at every point. At present, three types of light-weight aggregate are being used—cinders, haydite and pottsco. Other light-weight aggregates are being developed, but from the experience of the last few years these are not going to be available to every manufacturer who wants to make a lighter unit.

Units Designed for Light Weight

Obviously there are a number of distinct advantages to the manufacturer who can lighten the weight of the unit he is now manufacturing or who can make the necessary changes to produce light-weight concrete. If he is not able to secure light-weight aggregates he must therefore depend on design to achieve the results he is seeking. It is this design that this article treats—a design that has in the past year made a material saving for a number of concrete products manufacturers and has opened to them markets that they were not able to obtain before.

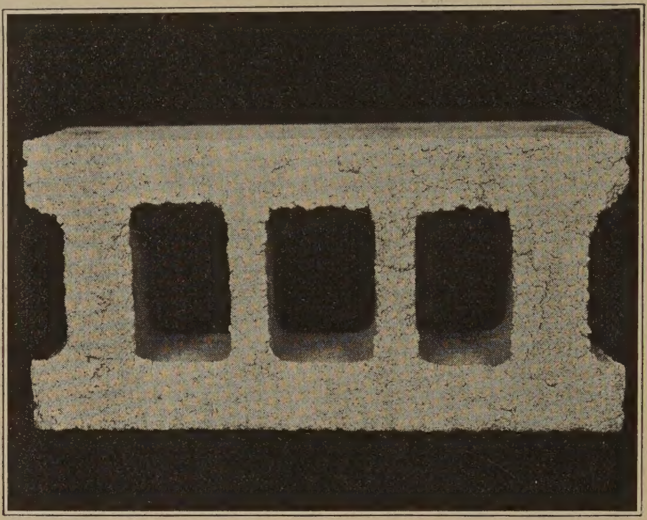

Figure 2. Bottom of 8-inch unit shown in Figure 1. Observe that cross-webs are thinner than shells

Widening the Market Territory

It is the belief of the writer that in many small com-

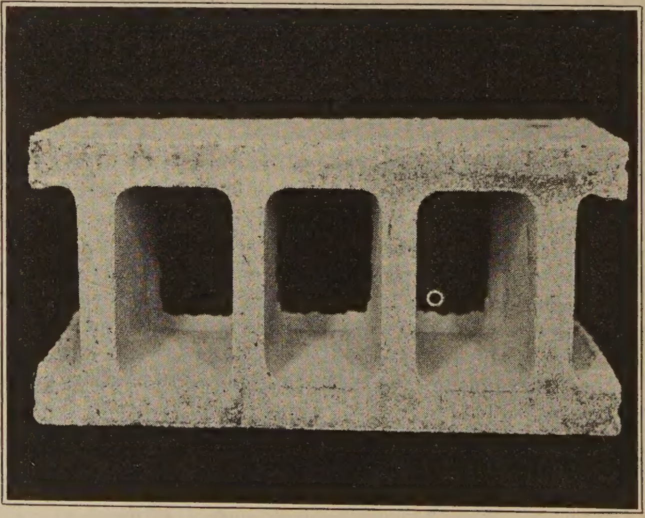

Figure 3. Bottom of 12-inch unit. Observe rectangular shape of air cells, corner fillets being absent

munities where a first class building unit is made, there would be a more widespread sale of this article if it could be made light enough in weight so that it might not only be transported easily to the surrounding farms, but might be shipped considerable distances and sold by building material dealers in localities where a first class unit is not made at present. One reason why clay tile has had such a widespread distribution among building material dealers is that it is much lighter in weight than present concrete building units that are made with ordinary aggregates. It has quite a distinct advantage because of its low freight rate. The writer looks forward to the time when efficiently operated plants in the concrete products industry will be selling a good share of their product through these same dealers who today are handling no concrete products.

How the Weight Is Reduced

During the past two years there have been a number of radical changes in design of the present so-called heavy concrete building unit. I was particularly impressed one day not long ago when a manufacturer from a nearby town, dropping in to my office, made the assertion that his 12-in. block—that is, a standard 8 by 12 by 16-in. unit—weighs 7 pounds less today than the 8 by 10 by 16-in. unit which he had been manufacturing a year ago. A corresponding saving in weight had also been made in the 10-in. unit. This change in design has come about largely by the adoption of rectangular instead of the familiar oval cores. One can readily see from this design that if material is taken out of the corners and the webs are thinned out to some extent the unit can be made considerably lighter. The writer had some experience with this type of unit two years ago, while associated with A. W. Friske, and although predictions were made that the thin-webbed unit with 50 per cent air space which he intended to manufacture would never stand up, tests started immediately after installation of the equipment showed them to be far in excess of local building code requirements. True, it takes considerable care in the manufacture of these units to see that the proper mix is used and that each is tamped a sufficient number of times, but when one considers that a saving of 6 or 8 pounds can be made on each unit this special care in manufacture is well worth while.

Units' Specifications

The manufacturer who was spoken of in the fore part of the preceding paragraph, and who is located at Cedar Grove, Wisconsin, is making units 7¾ in. high by 15¾ in. long. His average 8-in. unit weighs from 42 to 44 pounds. His average 10-in. unit weighs from 51 to 53 pounds, and his average 12-in. unit from 60 to 62 pounds. If the manufacturer reading this will take the units he is making at the present time and put them on a scale he can realize what a tremendous saving these seemingly few pounds can make in his manufacturing costs at the end of a year's time, or even at the end of any one month of continued production.

Cutting Corners Instead of Prices

A short time ago an advertisement appeared in the magazine "Printers Ink," written by a prominent printer who stated in quite bold type that "We do not cut prices but we do cut corners." All of us in the concrete products industry today are looking toward some method of cutting corners, and this proposition of making a lighter weight sand or stone unit certainly seems to be a most logical corner-cutting method. Not only will it be possible to ship to greater distances at lower freight costs but it will mean quite a material saving in trucking to local markets. Aside from this may be listed the savings made in material and in handling in the yard. Added to this is the sales argument that the lighter unit is easier for the mason to handle and lay in the wall.

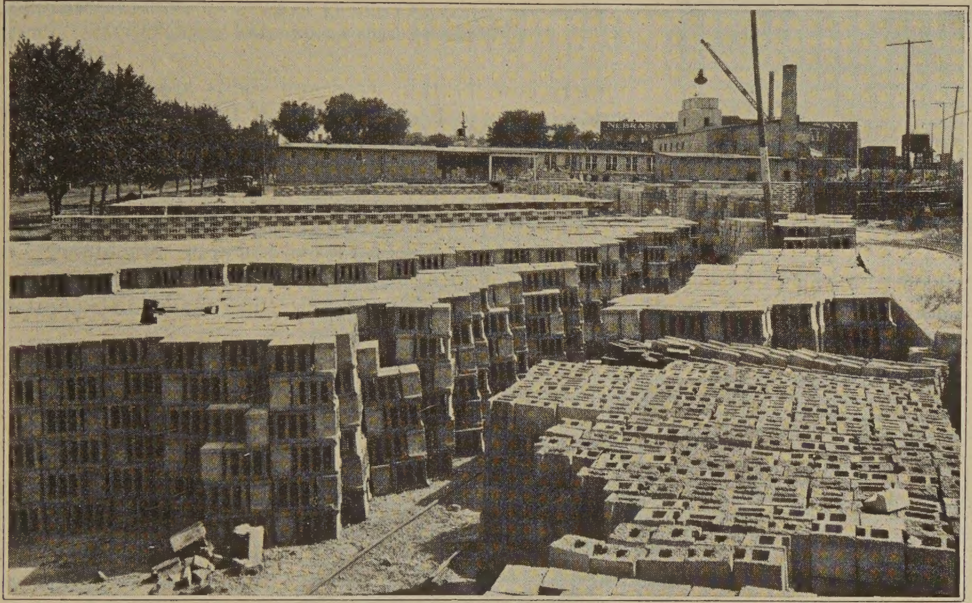

Figure 4. Thin-webbed units in storage yard of Ideal Cement Stone Co.

Care Required in Manufacture

One important thing that must be understood about the manufacture of this light-weight, thin-webbed unit is that machinery manufacturers should not attempt to place equipment in the hands of the ordinary manufacturer who uses only ordinary or slipshod methods of manufacture. When a thin-webbed unit is being made it requires careful supervision of the mix and the manufacturing operation, and should only be handled in a high-grade plant having a reputation for high-grade products.

At the present time two plants in Wisconsin have changed over to make this type of unit—the Cedar Grove Concrete Products Company at Cedar Grove, and A. W. Friske, of Milwaukee. The Saffert Cement Construction Company, of New Ulm, Minnesota, have but recently adopted the manufacture of this unit, as have the Ideal Cement Stone Company, of Omaha, Nebraska. All of these plants have for many years made high-grade concrete products and are experiencing no difficulty in the manufacture of the new light-weight, thin-webbed units. It can be easily seen from a saving in weight that a denser, stronger block can be obtained with the use of no more cement per unit than in the present 40 to 45 per cent air space block.

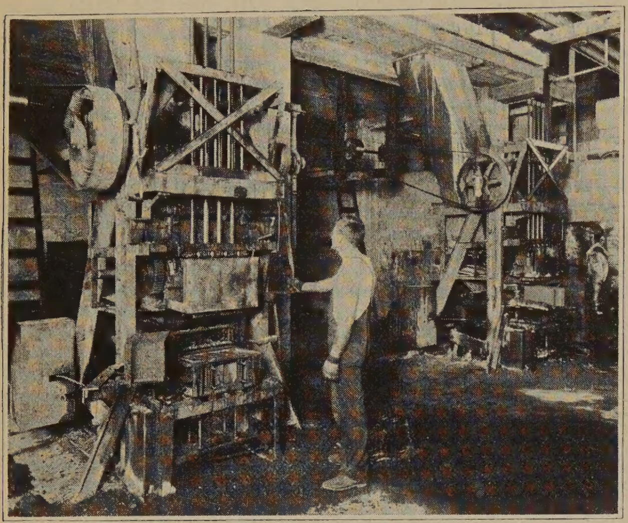

Figure 5. Interior of Ideal Cement Stone Co. plant in Omaha

Typical Unit

A number of illustrations made from photographs of these units accompany this article. Particular attention is invited to Figures 1 and 2, which show the top and bottom, respectively, of a typical unit made at the Omaha plant of the Ideal Cement Stone Co. These pictures show clearly how the thin webs and shells are flared out at the top so as to increase the area of the mortar bed. This is an important feature of the design.

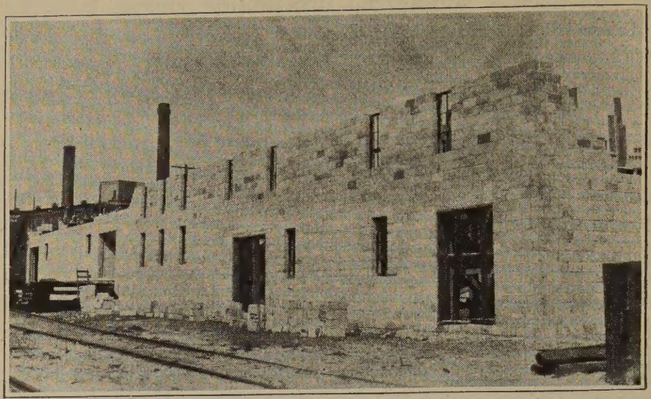

Figure 6. Industrial building under construction in Milwaukee, built of light-weight sand mortar units

Installations

The photographs were furnished the writer through the courtesy of the Consolidated Concrete Machinery Corp., which has done much toward stimulating the production of this type of unit and which has made the installations mentioned above.

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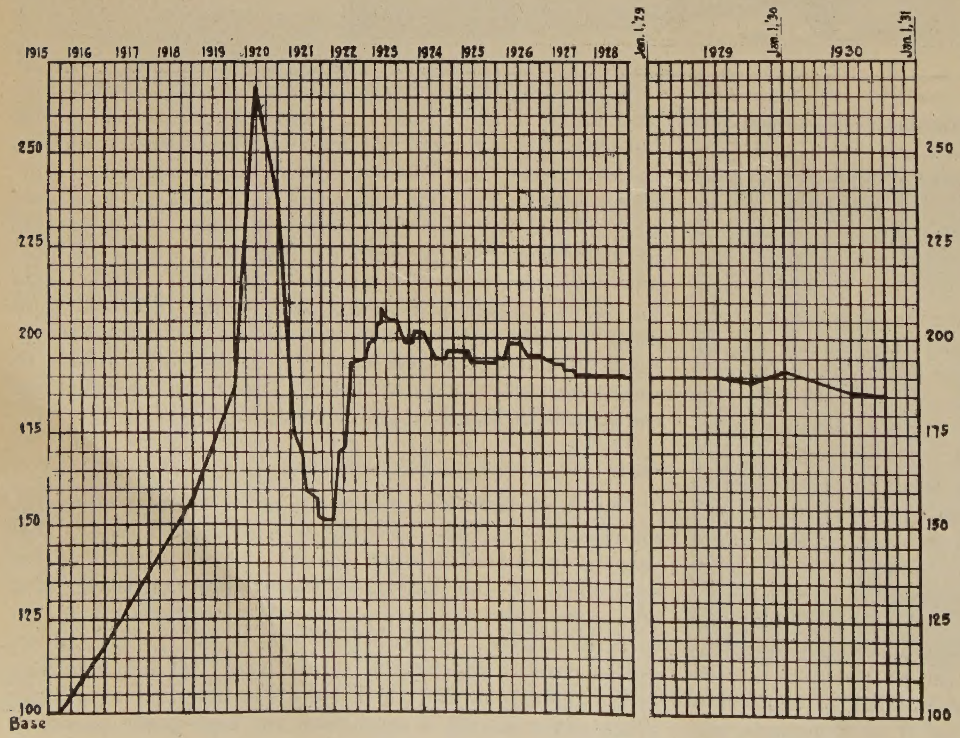
Aberthaw Index of Cost of Building



The Aberthaw Index of Cost of Industrial Building as of October 1, 1930, shows a further slight decline to 185, the change being due principally to a reduction in the cost of steel bars. This index figure represents a cost of $1.94 per sq. ft. of floor area for the 7-story reinforced concrete industrial building used as a basis for the figures.

Building materials appear to have reached a low price level and there is little probability that the present year will see an appreciable change. Producers' stocks are, however, exceedingly low and any local excess of demand over supply may cause variations in particular cases.

Although the volume of new construction has been below normal and there is considerable unemployment in the building trades, labor rates in some localities have increased.

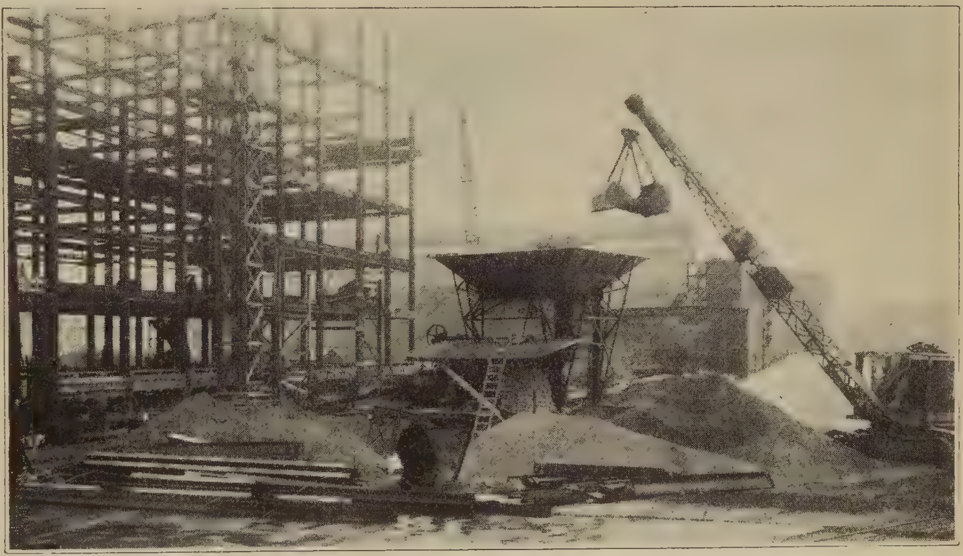
Attaining Low Cost in Mixing and Placing

Take Advantage of Shipping Facilities—Handling Aggregates, Cement and Concrete—Cost of Mixing and Placing—Crane Has Many Uses

By CHARLES C. MOODY
Supervising Engineer, The J. B. French Company, Chicago, Ill.

THE total quantity of concrete in a particular job will determine how much the contractor can afford to spend on concreting equipment. In other words, the efficiency and modernization of the mixing equipment will be dependent upon the total yardage.

Just what the proper ratio is cannot clearly be defined by anything except cold figures. How much one can be allowed for equipment depends upon conditions to a certain extent; but it also depends upon whether the contractor can afford to put in a large outlay of equipment when there is but a small amount of concrete to place.



Low-cost concrete mixing plant for new office building for the Inland Steel Co.

A Limit on Mixing and Placing Costs

The average small job contains, we will say, about a thousand cubic yards, and most of this will be in the foundations. When the contractor considers that, in order to place this concrete, he will figure about two dollars per cubic yard, he will realize that he cannot afford to spend a great deal on equipment. A small mixer, aggregate team-hauled directly to the mixer, and concrete wheeled from the mixer, tell the story. But suppose the yardage is double this amount. Then the contractor will find a different condition.

One of these jobs, where it became my duty to lay out and provide equipment, totaled approximately 2,000 cubic yards of concrete, and my cost limits were very low. The building in question was the recently completed office building for the Inland Steel Co., at Indiana Harbor, Ind. I will present the conditions of the job and show how these conditions were either utilized or overcome in order to bring the costs within the estimated figures.

The concrete was divided into two parts—500 cubic yards in the foundations and foundation walls and 1,500 in the floor slabs. We had two prices on our stone and sand, one price based on team delivery, the other based on delivery by cars alongside of the building. The latter price was 35 cents per cubic yard cheaper. The delivery track was about 150 feet from the center of the building.

Taking Advantage of Job Conditions

How to take advantage of the lower car delivery price on sand and stone and still come within our cost limits was a question. In wheeling from cars, in addition to unloading, we would have expended more than the extra cost of truck delivery.

We had a Blaw-Knox material hopper in our yard and not in use, and we also had a caterpillar gasoline crane equipped with a clamshell bucket which was not otherwise occupied. The boom of the crane had a drift of about 40 feet, which meant that we could unload cars with this crane and dump into our hopper and remove about 80 feet of the distance from the building. This left an average distance of about 70 feet, which ordinarily would have been the usual distance from material piles to the hoisting bucket.

It occurred to me that by raising the aggregate hopper from the ground a little higher than usual we could place the mixer close to the hopper and chute the mixture directly into the hoist bucket, thereby eliminating wheeling entirely. We put the hopper on extension legs sufficiently high to permit dropping the aggregates directly from the measuring bins into the mixer. The mixer was placed far enough above the ground to insure a sufficient fall from the spout to the hoist bucket, and we were all set to go.

A Mixing Plant Crew of Three Men

When we started mixing we had just three men for our mixing force. These consisted of an engineer to run the crane, a cement man who dumped cement into the mixer and who also manipulated the levers to fill and empty the measuring hoppers, and a man to run the mixer. This crew represented a total cost of $32.00 per day for eight hours of mixing.

Cost of Mixing and Placing

For the placing we used the usual methods—2-wheeled buggies. In the placing crew we used a hoisting engineer, six buggy men and a foreman. Our total daily cost for placing was about $72.00. This gave us a total labor cost for mixing and placing of about $104.00 each eight hours, and our average unit cost was close to seventy cents per cubic yard of concrete.

Our previously estimated cost for mixing and placing the concrete was $1.50 per cubic yard, so that the total saving was about $1,600. However, the additional labor and equipment used to bring this about was as follows: The cost of bringing the crane to and from the job was $150. Hauling and setting up the hopper and later dismantling it was a trifle more than $400. This finally left us a total saving of about $1,000 after deducting these last two sums from the sum of $1,600 mentioned above.

For only 2,000 cubic yards of concrete this showing was unusually good. This meant that we mixed and placed the concrete for a total cost of only $1.19 per cubic yard, including the cost of assembling and dismantling the equipment.

Put Crane to Other Uses

During the interim, between runs of concrete, the crane either unloaded cars on the reserve pile or switched cars. We needed no switch engine while running concrete after a car was unloaded, because the hopper contained sufficient material to continue running while the next car was pushed or pulled out, in preparation for unloading.

In connection with the crane on this job, we found that it had numerous other uses. When not being used for concrete work it was unloading other materials from cars, or hoisting form work or lumber to the second or third floors. Brick was delivered in boxes by truck and it was a simple matter to pick up one of the boxes bodily and place it exactly where wanted near the hoist. Cement was piled on skips at the cars and picked up by the crane and deposited alongside the hopper, where it was unloaded and piled. This same crane also assisted in grading the earth around the job and back-filling around the foundation after completion of the building.

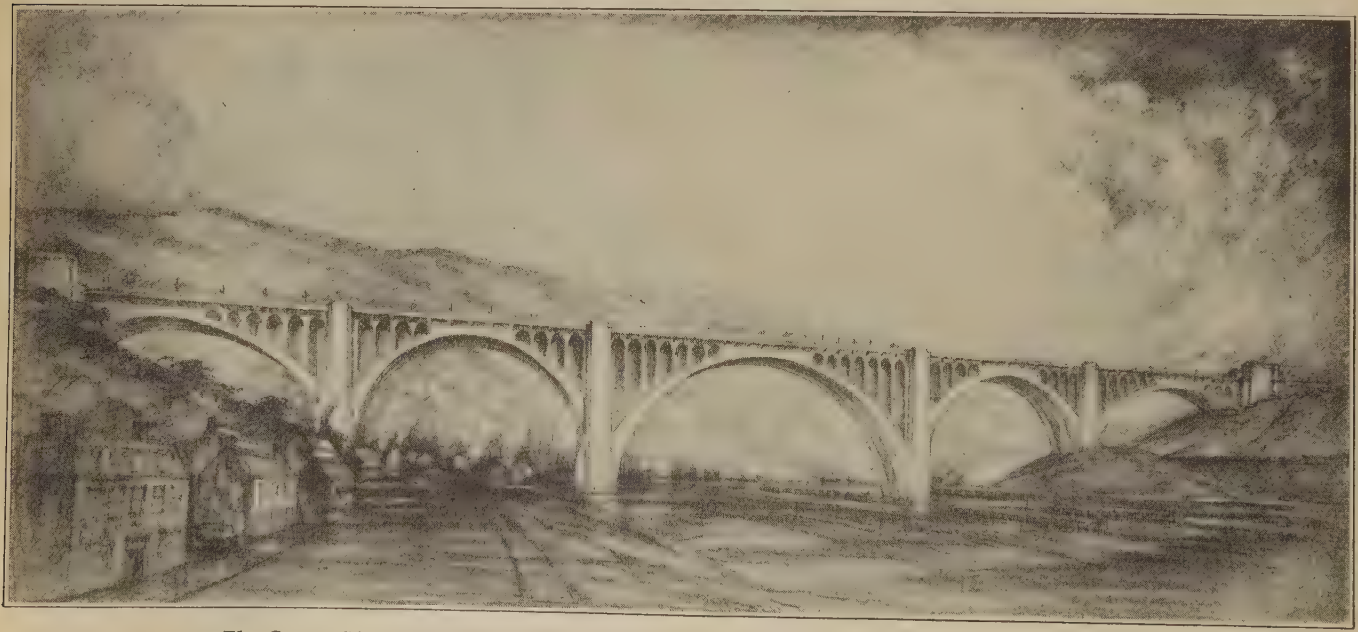
The J. B. French Company, of Chicago, had the general contract for this building. The architects were Graham, Anderson, Probst & White of the same city.

420 Foot Bridge Arch Span New Length in United States; Contract Let

Contract has just been let for what will be the longest concrete arch span in the United States when completed—a part of the George Westinghouse bridge over Turtle Creek on the Lincoln highway just east of Pittsburgh. The Allegheny County Department of Public Works has let the bridge contract to Booth and Flynn of Pittsburgh, whose figure was $1,482,754.50.

The following dimensions and quantities are involved: Total length, back wall to back wall, 1510.04 ft.; clear span, longest arch, 420.34 ft.; highest clear above ground line, 223 ft.; steel reinforcing, 3,500,000 lbs.; concrete in foundations, 20,600 cu. yd.; concrete above foundations in piers 30,550 cu. yds.; concrete in abutments, 5400 cu. yds.; concrete in arch ribs, columns, floor system and items not above, 17,800 cu. yds.

Norman F. Brown, director of public works, and V. R. Coval, chief engineer, bureau of bridges, were in charge of the design and will supervise construction.



The George Westinghouse bridge near Pittsburgh, Pa., which will include a 420 ft. arch span

~ EDITORIAL ~

The Architecture of Molded Concrete

AS a result of years of slow but steady growth, a new type of architecture has been developed. It is the architecture of molded concrete.

Whether dealing with wall faces or with exposed structural members, with exterior or interior details, this type of architecture leaves the concrete undisguised, serving both as a structural medium and an adornment. The architect depends partly on the general mass and form, partly on the surface technique, and partly on color, to get the effect he desires.

Thus has color found another medium through which it may appear as a part of architecture, either in the form of stains or paints, or in mineral colors mixed integrally with the concrete, or through the use of colored concrete aggregates. When properly combined with form, color provides a real relief from the drab appearance we are accustomed to seeing in so many of our buildings.

A fortunate phase of the development of this architecture is its generous use for buildings of the mercantile and industrial types. In times past we have been led to believe that unmixed ugliness must be a part of buildings of these occupancies, as a matter of economic necessity. Now we have ample evidence that warehouses, factory buildings, commercial garages and downtown business buildings, whether of large or small size, may have architectural merit if built of molded concrete.

In buildings of more pretentious architecture there seems to be no limit to the exterior and interior effects obtainable when the structure is in the hands of skillful architects and trained craftsmen. Great credit is due to the architects who have served as the pioneers in this development.

The Town's Best Concrete Man

THE builder who is considered the best concrete man in his town has a responsibility on his shoulders. He does the concrete work with which the public is most familiar. He builds the walks and drives, the concrete floors and foundation walls, and much of the concrete masonry work.

The quality of the concrete placed by this builder affects the degree of public confidence in concrete for larger projects.

For the sake of his own best interests the progressive builder of small concrete jobs should therefore remember that there are ways of making better concrete than he has been making. He must absorb new ideas from the best trade publications, from contacts with other builders, and from services offered by trade associations.

The concrete builder who neglects to improve his methods may lose his place as the town's best concrete man.

A Sound Policy in Secondary Road Construction

THE improvement of secondary roads is a matter that is getting increasing attention from state and county highway departments. The motive back of this interest is the desire to bring improved roads into sections not served by the main highways of the primary system, so that these regions may reach the markets all the year round.

Unfortunately there is too much of a tendency on the part of highway officials to think of these secondary roads as roads of little consequence, and to consider that inferior types of road construction will be sufficient to support the lighter traffic on them. These officials are losing sight of the financial difficulties into which their unsound policy is leading them, for unless history fails to repeat itself they will soon be spending all their available funds for maintaining these inferior types of roads instead of building additional mileage.

That is precisely the situation in which a number of state highway commissions have found themselves in times past. After spending millions to build primary highways of low first cost, but high maintenance cost, they found it necessary to spend their entire income on maintenance. Nothing was left for new construction.

Single-lane secondary roads should be built of concrete, of the same quality and the same slab thickness as in primary concrete roads. The higher first cost of the concrete road, as compared with the inferior type, will be more than offset, over a period of years, by its lower maintenance cost. Furthermore, a secondary road of this high-grade type of construction can at any time be incorporated in a primary system without wasting what has been built.

Vermilion County, Illinois, which has been building single-lane concrete roads since 1914, has been able to add mileage year after year, because of the businesslike policy being followed. Twenty-one miles were added during the first half of this year. Kent County, in Maryland, built 51 miles of single-lane concrete roads in 1929. The Missouri State Highway Department awarded contracts for 20 miles of such roads at one letting a few months ago.

The highway officials who are responsible for this high-grade construction for secondary roads know that the policy which has proved sound for primary road construction is equally sound for secondary roads.

PROGRESS—In a Page

Current activities in research, in matters pertaining to concrete and cement, as being carried on or completed by various organized groups.

List of American Engineering Standards

THE American Standards Association, 29 West Thirty-Ninth St., New York, has published a classified list of American engineering and industrial standards approved by that organization. Standards of interest to the concrete construction industry include the following:

A 1-1928—Specifications and Tests for Portland Cement.

A 2-1926—Fire Tests of Building Construction and Materials.

A 19-1923—Method of Test for Voids in Fine Aggregate for Concrete.

A 27-1924—Method of Test for Apparent Specific Gravity of Coarse Aggregates.

Copies of these publications can be obtained from the American Standards Association at 25 cents each.

Cast Stone Institute Developing Research Program

The Committee on Research of the Cast Stone Institute is actively at work on its program of research, which is to be reported in the near future. It is expected that the committee will recommend that immediate steps be taken to see that the product of all members complies fully with the requirements of the institute's specifications (reprinted on pages 33 and 34 of the September, 1930, issue of CONCRETE).

Cast stone manufacturers whose products fall below the standard requirements will be given assistance with the view of bringing about the necessary improvement in quality.

Canadian Reinforcing Steel Specifications Revised

THE Canadian Engineering Standards Association, 178 Queen Street, Ottawa, Ontario, Canada, announces publication of its revised specifications for steel reinforcement. The serial numbers and titles of the revised standards are—

G 30-1930—Standard Specifications for Billett-Steel Reinforcing Bars.

G 31-1930—Standard Specifications for Rail-Steel Reinforcing Bars.

G 32-1930—Standard Specifications for Steel Wire for Concrete Reinforcement.

These three publications now supersede the former single standard A9-1923, entitled "Standard Specification for Reinforcing Materials for Concrete." Compared with the former specification just mentioned, the upper limit in tensile strength for intermediate grade billet-steel has been raised from 85,000 to 90,000 lb. per sq. in., and the minimum elongation has been fixed at 16 per cent for plain bars and 14 per cent for deformed bars.

Study Elastic Properties of Concrete

IN co-operation with the Aluminum Company of America, the United States Bureau of Standards has completed a series of tests on 24 by 48 in. concrete cylinders to determine the relation between loads and longitudinal and lateral deformations. The cylinders were made from concrete being placed during the construction of the Calderwood dam in Tennessee.

The results of the tests are reported in Technical News Bulletin No. 162, for October, 1930, pages 102-103, issued by the Bureau of Standards. In general, both longitudinal and lateral deformations were found to be proportional to the load applied, over the entire range of loading from 0 to 1,400 lb. per sq. in.

Engineering Index Service Introduced

THE Engineering Index Service, a division of the American Society of Mechanical Engineers, 29 West Thirty-Ninth St., New York, has inaugurated a service designed to review, classify and record articles dealing with every branch of engineering as they appear in the current technical literature of the world.

A staff of engineering editorial writers and linquists will regularly review more than 1,800 domestic and foreign current technical publications coming from 37 countries and printed in 18 different languages.

Dues in National Ready-Mixed Concrete Association

Dues for membership in the National Ready-Mixed Concrete Association have been established on a sliding scale based on the population of the city in which the concrete plant is located. On this basis the annual dues are as follows:

Population of City	Annual Dues
50,000 or less	$ 50
50,000 to 100,000	100
100,000 to 250,000	150
250,000 to 500,000	250
500,000 or more	300
Associate Membership	100

Proposed Specification for Masonry Cement

COMMITTEE C-1 of the American Society for Testing Materials, in its report to the annual meeting at Atlantic City, discusses its progress in the collection of data from which the committee may prepare a specification for masonry cement. A questionnaire sent to 23 manufacturers of masonry cements brought 15 replies. The data supplied from this source should form a good working basis, although the great variation in the characteristics of these special cements will make it difficult to develop a standard specification.

How to Save in Concrete Form Work

Form Work Around Steel Beams—Assembly and Removal of Floor Forms—Lens Sidewalks

XI—Floor Forms in Steel-Framed Building—Miscellaneous Items

By A. B. MacMILLAN
Chief Engineer, Aberthaw Company, Boston, Mass.

THE most important subject-matter of this article is represented by Figure 53, showing details of the form work around steel beams and in the intervening floor panels of a building having a steel frame encased in concrete.

The details of Figure 53 tell the story quite thoroughly, so that space will be available to describe and illustrate the form work for certain accessory parts of a building. Any building, whether of reinforced concrete or of concrete-encased steel frame construction, will have accessory parts such as lens sidewalk work, window sills, parapet copings, and similar items, for which form work will be needed. In Figures 54, 55 and 56, form work details are given for the parts just named, inasmuch as these are likely to occur in almost every building. Others might be included, but it seems best to limit the details to the items shown in those three drawings, rather than to attempt the impossible by trying to include every special detail that might occur.

Form Work Around Steel Beams

The forms for encasing the columns for a steel-framed building do not differ materially from the details shown in previous installments of this series.

Form work for the floor construction, on the contrary, differs essentially from that of a reinforced concrete building, due to the fact that the form work is supported by the beams and girders of the steel frame.

The form details for such floor construction are well illustrated in Figure 53. As shown in the lower left-hand corner of that drawing, the entire form work is supported on short cross-pieces of 3-by-4's, about 27 inches apart, held in place against the beam bottom by wire passed around the cross-piece and over the steel beam and tightened by twisting above the top flange of the beam. Because of the heavy loads the wires are required to support, we use No. 3 for heavy work and No. 6 for comparatively light work. The wires pass through the form work at the edges of the beam bottom, with the beam sides set against them and supported on the 3-by-4 cross-pieces previously mentioned.

Care must be taken to insure that the wire is bent to a snug fit around the flange of the I-beam and the ends secured snugly.

In some cases where the I-beams are spaced close together continuous 3-by-4's are used instead of the short separate bottom cleats. In this case, the beam sides and

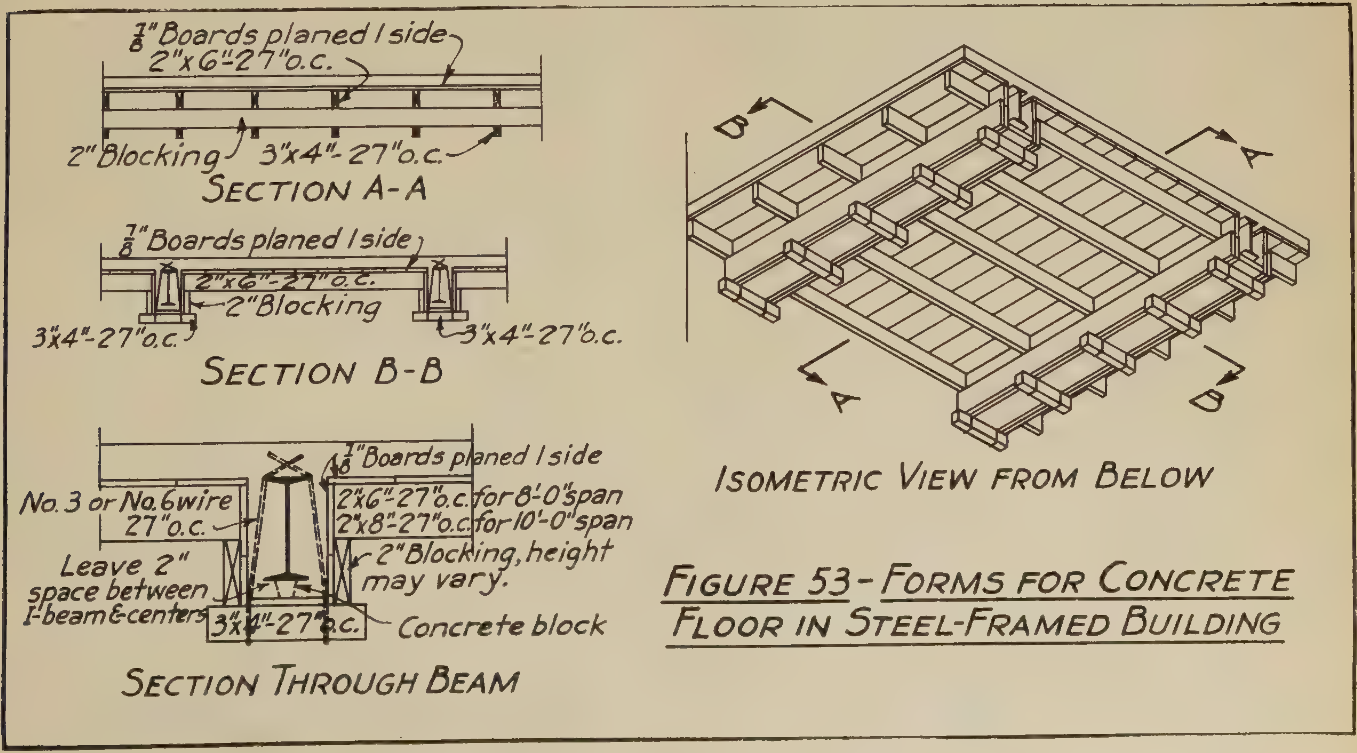
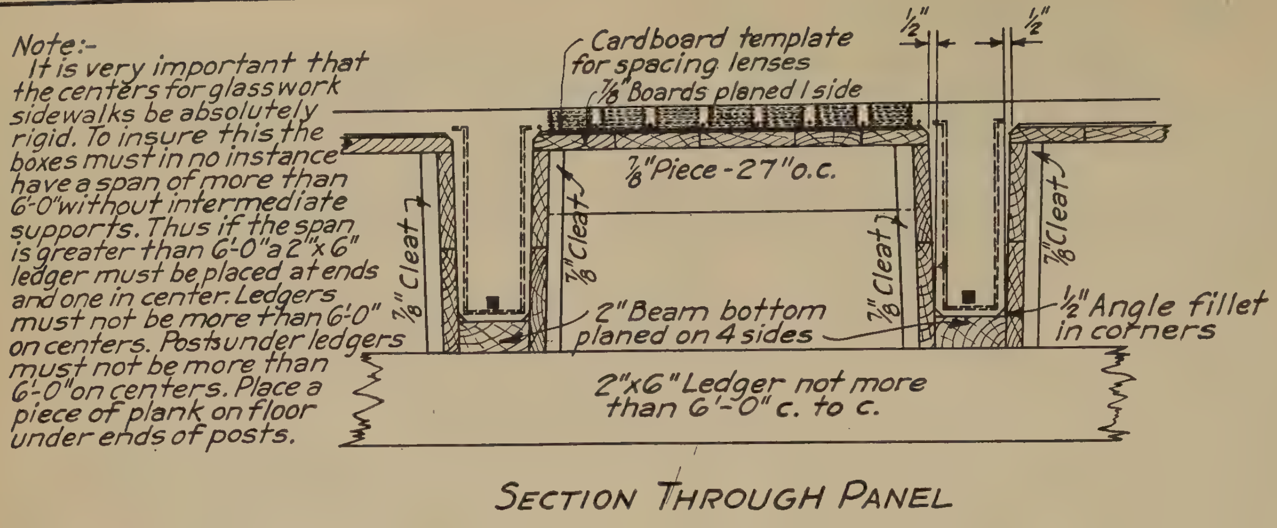

7/8" Boards planed 1 side
2"x6"-27"o.c.
2" Blocking
3"x4"-27"o.c.
SECTION A-A
7/8" Boards planed 1 side
2"x6"-27"o.c.
2" Blocking
3"x4"-27"o.c.
3"x4"-27"o.c.
SECTION B-B
7/8" Boards planed 1 side
No. 3 or No. 6 wire 27"o.c.
2"x6"-27"o.c. for 8'-0" span
2"x8"-27"o.c. for 10'-0" span
2" Blocking, height may vary.
Leave 2" space between I-beam & centers
3"x4"-27"o.c.
Concrete block
SECTION THROUGH BEAM
A
A
B
B
ISOMETRIC VIEW FROM BELOW

FIGURE 53 - FORMS FOR CONCRETE FLOOR IN STEEL-FRAMED BUILDING


Note:-
It is very important that the centers for glasswork sidewalks be absolutely rigid. To insure this the boxes must in no instance have a span of more than 6'-0" without intermediate supports. Thus if the span is greater than 6'-0" a 2"x6" ledger must be placed at ends and one in center. Ledgers must not be more than 6'-0" on centers. Posts under ledgers must not be more than 6'-0" on centers. Place a piece of plank on floor under ends of posts.
Cardboard template for spacing lenses
⅞" Boards planed 1 side
½"
½"
⅞" Piece - 27" o.c.
⅞" Cleat
⅞" Cleat
⅞" Cleat
⅞" Cleat
2" Beam bottom planed on 4 sides
½" Angle fillet in corners
2"x6" Ledger not more than 6'-0" c. to c.

SECTION THROUGH PANEL

FIGURE 54 - FORMS FOR LENS SIDEWALKS

ends, together with the floor panel, are made up as a box and simply set in place on the 3-by-4's.

To prevent an open joint and consequent leakage of mortar, due to the presence of the wires between the beam bottoms and sides, it is well to use softwood lumber for the beam bottom. If that precaution is taken, the wires can be hammered well into the edge of the beam bottom, thereby closing the joint. It is possible, of course, to cut small notches into the beam bottom at the edges of each cross-piece, but that is a slow and rather tedious process that adds a considerable item to labor costs.

Observe that the beam bottom of the form work is held at the proper distance below the bottom flange of the steel beam by small precast concrete blocks.

Assembling the Floor Forms

The form work for the floor construction in Figure 53 is assembled, first, by tacking the beam bottom plank to the 3-by-4 cross-pieces, the latter serving as cleats, then wiring this assembly to the steel beams. The wires are tightened after the small concrete blocks are inserted between the beam bottom plank and the lower flange of the steel beam.

The width of the beam bottom must be 4 inches more than the width of the bottom flange of the steel beam, thereby leaving a space of 2 inches on each side of the flange for the concrete to pass through. This is the amount of space required by most city building codes, and it is required by the rules of good practice.

Next the lower boards of the beam sides are set in place, then 2-inch planks that serve as blocking for the floor joists are set on the cross-pieces, and the lower boards of the beam sides are tacked lightly against them. These 2-inch blocking planks must be dressed to whatever width is required to make up the vertical distance from the cross-pieces to the bottom of the floor joists.

Finally the floor form panels are placed and the upper boards of the beam sides are set into place and tacked lightly to the ends of a few of the joists. The floor panels have previously been assembled by nailing the ⅞-inch boards to the joists. If enough men and enough hoisting equipment are available, a floor form panel may be made up to the full area of the floor panel. If for any reason lighter form units are necessary or desirable, several smaller form panels may be used instead of a large one.

Note especially that the ⅞-inch boards of the floor panel project over the beam sides. Removal of this form work will be made easier if the floor boards adjacent to the beam are omitted from the assembled panel. They may be set in place and lightly tacked after the floor panel is set. Then, when the form work is removed, the floor panels can be lowered as soon as the 2-inch plank blocking is taken away.

Removal of Floor Form Work

The following procedure may be followed in removing the floor form construction shown in Figure 53:

(1) Shore up one edge of a floor form panel by a temporary frame consisting of a 3-by-4 timber fastened by scabs to the top of two 3-by-4 posts.

(2) Cut the wires at the beam where the floor panel

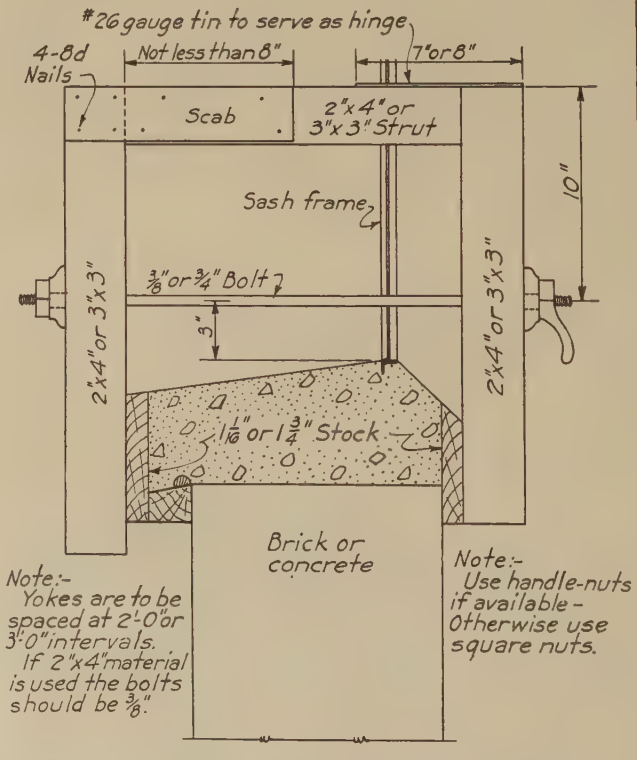
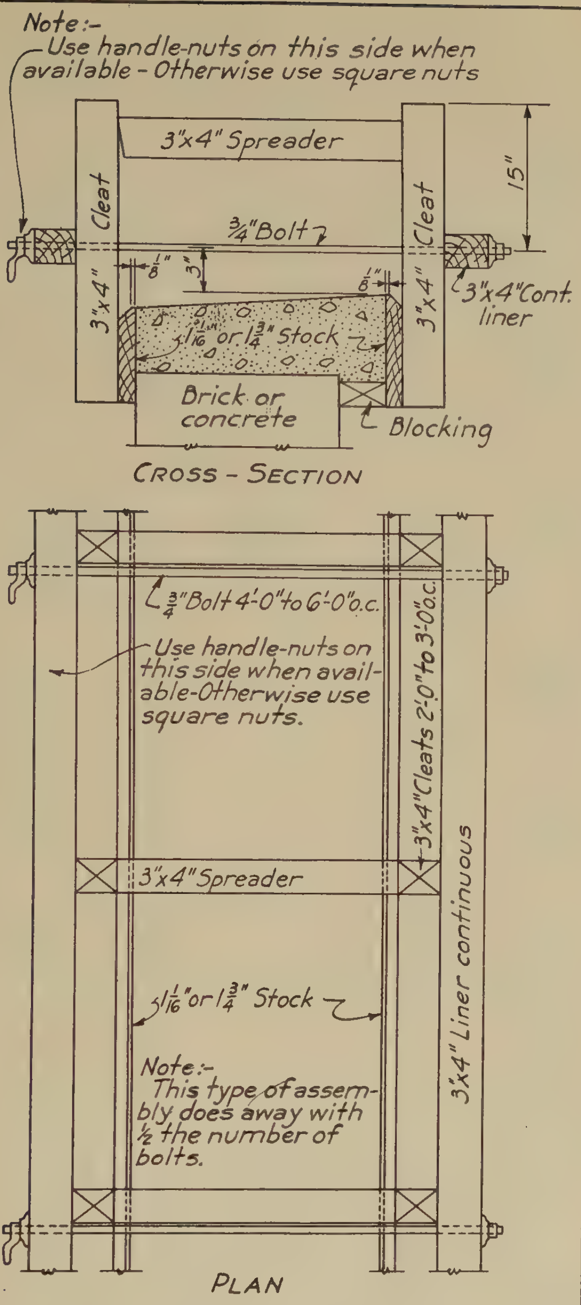

#26 gauge tin to serve as hinge
4-8d Nails
Not less than 8"
7" or 8"
Scab
2"x4" or 3"x3" Strut
10"
Sash frame
⅜" or ¾" Bolt
3"
2"x4" or 3"x3"
2"x4" or 3"x3"
1 1/16" or 1¾" Stock
Brick or concrete
Note:-
Yokes are to be spaced at 2'-0" or 3'-0" intervals.
If 2"x4" material is used the bolts should be ⅜".
Note:-
Use handle-nuts if available - Otherwise use square nuts.

FIGURE 55 - FORM WORK FOR WINDOW SILL


Note:-
Use handle-nuts on this side when available - Otherwise use square nuts
3"x4" Spreader
15"
Cleat
Cleat
3/4" Bolt
1/8"
3"
3"x4"
3"x4"
3"x4" Cont. liner
1 1/16" or 1 3/4" Stock
Brick or concrete
Blocking
CROSS - SECTION
3/4" Bolt 4'-0" to 6'-0" o.c.
Use handle-nuts on this side when available-Otherwise use square nuts.
3"x4" Cleats 2'-0" to 3'-0" o.c.
3"x4" Spreader
3"x4" Liner continuous
1 1/16" or 1 3/4" Stock
Note:-
This type of assembly does away with 1/2 the number of bolts.
PLAN

Sides and cleats are nailed together, making a unit. Spreaders are separate pieces. 3"x4" liners with bolts through them are a unit. These are continuous and should be in 14 to 18 foot lengths.

FIGURE 56 - FORM WORK FOR COPING

is shored, and remove the 3-by-4 cross-pieces and the beam bottom. At the same time remove the 2-inch blocking and the lower boards of the beam sides, which, as previously stated, were tacked lightly to the 2-inch blocking.

(3) Let down the edge of the floor panel by lowering the temporary shoring frame, and remove the panel and upper boards of the beam sides.

(4) The ends of the wires protruding from the concrete may be cut off flush with the concrete unless they are needed to assist in supporting metal lath and plaster.

Lens Sidewalks

The details in Figure 54 are sufficiently clear, and the explanatory note lettered on the drawing covers about all that needs to be said in connection with this work. The form work consists essentially of boxes supported on ledges, the beam sides being slightly battered to facilitate removal of the boxes.

Forms for Window Sills

Figure 55 illustrates clearly the form work for a window sill. This is seen to consist essentially of yokes shaped like the inverted letter "U." The purpose of the 26-gauge tin strap at the upper right-hand corner of the drawing is to provide partial hinge action so that the yoke can be released.

While the drawing indicates the use of either 2-by-4 or 3-by-3 pieces for the yoke, the 3-by-3's are best. Even if 3/8-inch tie bolts are used, the bolt holes take too much out of the thickness of a 2-by-4.

Forms for Parapet Copings

The form work for parapet coping involves keeping a true alignment for long stretches of wall. For that reason it is best not to depend on yokes, as with window sills, but to use continuous liners of 3-by-4 material in combination with 3-by-4 cleats and spreaders. It is best to stagger the liners with respect to those on the opposite side of the coping, since this will assist in maintaining the alignment.

The cross-section and plan in Figure 56 clearly illustrate all the elements of the form work for copings.

Merchandising to Be Main Subject of Products Associations' Annual Sessions

Merchandising—not the technology or manufacture—of concrete products will be the principal subject at the joint sessions of the Concrete Masonry Association and the Wisconsin Concrete Products Association, to be held at Milwaukee, beginning the morning of February 23rd, at the Schroeder Hotel.

The American Concrete Institute sessions, to be held in the same city, will cover other of the products man's interests. Its sessions will be held beginning the 24th but will not conflict with those of the products associations.

Coming Conventions

January 10-16—American Road Builders Association, convention and road show, St. Louis, Mo.

January 19-22—National Crushed Stone Association, fourteenth annual convention. New Hotel Jefferson, St. Louis, Mo.

February 23-26—Concrete Masonry Association and Wisconsin Concrete Products Association, joint annual convention. Hotel Schroeder, Milwaukee, Wis.

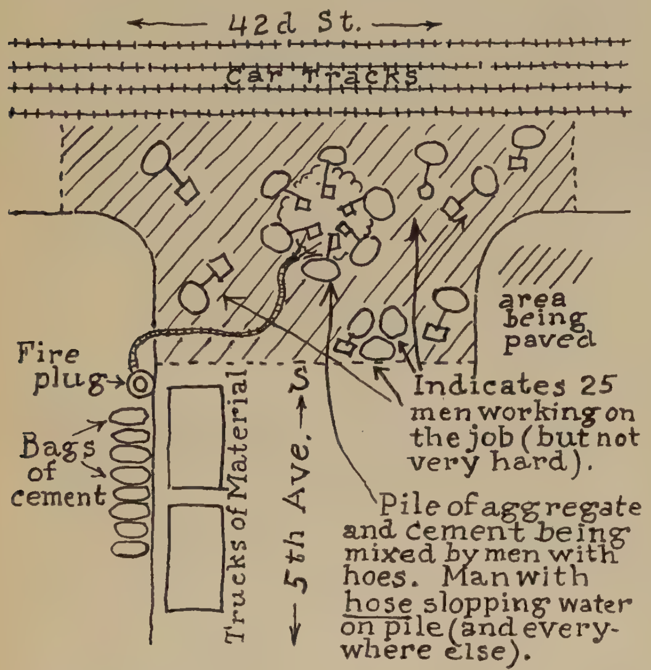
February 24-26—American Concrete Institute, annual convention. Hotel Schroeder, Milwaukee, Wis.

How *Not* to Do It

New York City,
October 5, 1930.

Editor of CONCRETE:

Just came by Fifth Avenue and 42nd Street and saw a most beautiful picture of how not to lay a new concrete pavement on the busiest corner in the world. It was like this—


42d St.
Car Tracks
area being paved
Fire plug
Bags of cement
Trucks of Material
5th Ave.
Indicates 25 men working on the job (but not very hard).
Pile of aggregate and cement being mixed by men with hoes. Man with hose slopping water on pile (and everywhere else).

If I'd had a camera I could have made a wonderful picture of modern street paving methods. There was no ready-mixed delivery on this job—and no mixer on the job. There may have been one wheelbarrow, but I don't recall seeing one. One workman was placing and leveling off concrete next to the car track with a street sweeper's broom.

I counted the men. There were 23 in sight and several more behind the trucks; at least 25 in all. It was an inspiring sight.—H. P. O.

High-Early-Strength Concrete Pavement Opened in Four Days

Tests Indicated Strength Exceeding 2,500 Lb. per Sq. In. When Traffic Was Turned On—Carefully Designed Mixture Employed

A high-early-strength concrete pavement, opened to heavy truck traffic in 4 days, was recently built for the Morton Salt Company at its new refinery and warehouse in Chicago. The pavement is on the south half of a dead-end street and was built by private contract because the only other abutting property owner did not use that street.

The slab is 19 ft. wide and 10 in. thick. It is reinforced with a layer of mesh weighing 78 lbs. per 100 sq. ft. placed 2 in. from the bottom and another layer weighing 58 lbs. per 100 sq. ft. 2 in. from the top. A sand having an average fineness modulus of 3.00 was used for fine aggregates and gravel ranging in size from 1/4 to 2 in. for coarse aggregate.

Design of Concrete Mixture

The concrete was designed to have a minimum compressive strength of 2,000 lbs. per sq. in. or an average of 2,500 lbs. per sq. in. in 4 days. The proportions were 1:1.6:2.2, damp and loose measure, using standard portland cement. The cement content averaged 1.97 bbls. per cu. yd. of concrete. A water-cement ratio of 5 gallons per sack, with this mixture, produced the desired slump of 1½ in. The average temperature during the 4-day curing period was 50 deg. F. The mixing time ranged from 1¼ to 1½ minutes.

Materials were proportioned at a central plant and hauled to a Foote 27-E paver in 3-batch trucks. An 8-sack batch was used. The pavement was cured with a surface application of calcium chloride.

Results of Cylinder Tests

Standard 6 by 12-in. compression cylinders were made and tested at ages of 3, 4, 7 and 28 days. Three cylinders were tested for each of these ages and the strengths given in the table are the average of those 3 tests.

Compressive Strength of High-Early-Strength Concrete

Number of Cylinders	Age of Test, in days	Average Compressive Strength, in Lb. per Sq. In.
3	3	1800*
3	4	2866
3	7	3425
3	28	4663

*There was a wide range in the strength of the 3-day cylinders, apparently caused by a pocket of coarse aggregate in the center of one of them. That explains the large increase in strength between the 3 and 4 day cylinders, as the average of the 3-day is probably low.

Graham, Anderson, Probst and White, architects for the recently completed salt plant, designed the pavement. The work was done by the Marquette Construction Company under the direct supervision of J. A. Fitzharris.

Emo Tile Is New Wall and Roof Unit

Emo tile, a 2 or 4 cell wall and roofing unit featuring a high degree of insulation, is now being marketed in Detroit by the Emo Tile Company, headed by Edward M. Olson.

The tile are made in 2 by 6-ft. sizes, with two thicknesses of concrete and one of insulation material, enclosing one or two air cells, according to the type of unit.

A similar construction is followed in the wall units, which come in smaller sizes, and are reinforced. Preparation for lathing is carried on the wall units.

New York Meeting of Joint Committee Gets Work Under Way

THE reorganized Joint Committee on Specifications for Concrete and Reinforced Concrete, at a meeting held in New York on October 2nd and 3rd, parceled out its work to the various separate committees and made a definite start on the task ahead of it. Each of the separate committees held a meeting on October 3rd for the purpose of completing their committee organizations and discussing their own assignments.

Following are the separate committee designations and the names and addresses of the committee chairmen:

Committee 1, *on Materials* (*Other than Reinforcing*)—F. H. Jackson, Bureau of Public Roads, Washington, D. C., chairman.

Committee 2, *on Metal Reinforcement*—Leon S. Moisseiff, consulting engineer, 68 William St., New York, chairman.

Committee 3, *on Proportioning and Mixing*—Prof. F. E. Richart, University of Illinois, Urbana, Ill., chairman.

Committee 4, *on Forms and Placing*—C. P. Richardson, engineer of track elevation, C. R. I. & P. Ry., 803 LaSalle St. Station, Chicago, chairman.

Committee 5, *on Design*—Prof. S. C. Hollister, Purdue University, Lafayette, Ind., chairman.

Committee 6, *on Details of Construction and Fireproofing*—J. F. Leonard, engineer of bridges and buildings, Pennsylvania R. R., 729 Pennsylvania Station, Pittsburgh, chairman.

Committee 7, *on Waterproofing and Protective Treatment*—P. H. Bates, chief of ceramics section, U. S. Bureau of Standards, Washington, D. C., chairman.

Committee 8, *on Surface Treatment*—J. H. Chubb, manager of service department, Pennsylvania-Dixie Cement Corp., 521 Fifth Ave., New York, chairman.

The next meeting of the Joint Committee is to be held in Chicago early in February.

Personals

Prof. J. H. Dorrah, formerly dean of the engineering department of the University of Mississippi, has been appointed head of the civil engineering department at the University of New Mexico, Albuquerque, New Mexico.

T. G. Gladney, former professor of civil engineering at the Mississippi Agricultural and Mechanical College, is now dean of the engineering department at the University of Mississippi, at University, Miss.

Reinforced Concrete Design Simplified

Chart I (20,000; 1,200; 10)

Reinforced Concrete Slabs

American Concrete Institute Building Code

$f_s = 20{,}000$ lbs. per sq. in.
$f'_c = 3{,}000$ lbs. per sq. in.
$f_c = 1{,}200$ lbs. per sq. in.
$n = 10$
$K = 197;\ p = 0.0112$

By JAMES R. GRIFFITH
Professor of Structural Engineering, Oregon State Agricultural College

As stated previously, Chart I gives the depth of slab and area of necessary steel for balanced reinforcing. In other words, for the load and span used, the steel and concrete stress will be up to the maximum allowable. In large floor areas it sometimes becomes necessary to maintain a constant thickness of slab although span and load conditions vary. Maximum conditions dictate the slab thickness used under such circumstances. This will permit a reduction of steel in locations of less severe flexure.

Whether or not it is economical to reduce the steel area, or maintain the same reinforcing, is controversial. The designer will see only tonnage. The construction man will think in terms of labor and inspection.

An interesting diagram appeared on page 19 of the September issue of CONCRETE. It gave proportions of labor and material making up the cost of a reinforced concrete building. Reinforcing steel was credited with 13.0 per cent, while the labor of placing the steel was 2.2 per cent of the total building cost. It would appear, from this, that a reduction in steel tonnage would reduce the total cost by a larger percentage than by watching too closely the labor cost, which is almost insignificant.

Be that as it may, I want to discuss ways of obtaining the steel area for a slab thicker than is warranted for span and load conditions. Some designers will use an approximate value of $j = 7/8$, solving for the necessary steel area, and checking the stress. Another approximation is to use Chart I. Use the steel required for the lesser conditions although it may be in a slab thicker than is necessary. While an approximation, this last is on the side of safety.

In the August issue of CONCRETE, an announcement was made to the effect that beginning with the first of the year I would present other charts of interest to the designer. The above problem of unbalanced reinforcing will be the first presented. It is a provoking problem to the beginner, although not difficult. It can be solved quite simply by chart.

In connection with the charts to come, I will welcome suggestions of routine problems for which the readers want charts prepared. I will, however, not promise to deliver in all cases. The author of a well-known text on reinforced concrete asked me several years ago if a certain problem could be solved by chart. Yes, it could, but only with a chart too complex to be an advantage.

The contours of equal load for the chart herein presented were plotted from the general equation

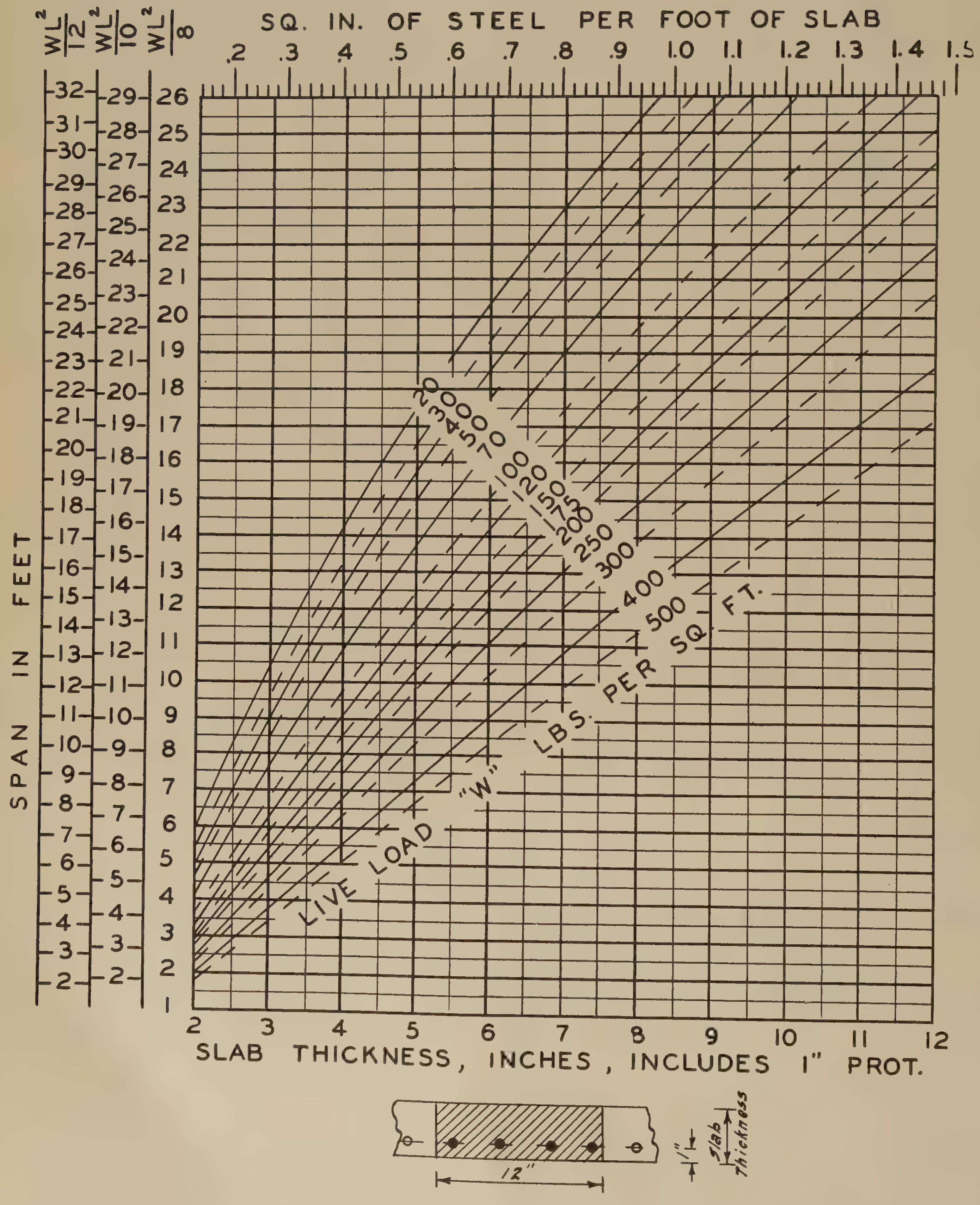
$$1^2 = \frac{8K\,(D\text{-}1)^2}{(w_{\mathrm{L.L.}} + 12.5\,D)}$$

For the stresses considered, $K = 197$. In laying out the scale for area of steel, a value of $p = 0.0112$ was used. Otherwise this chart is identical with those of similar type previously described.

CHART I (20,000; 1,200; 10)

Reinforced Concrete Slabs

$f_s = 20{,}000$ lbs. per sq. in.
$f_c = 1{,}200$ lbs. per sq. in.
$n = 10$



Circular Concrete Arch Dam Designed by Simple Method

Horizontal Section of Dam Considered as Section of Hollow Cylinder—Previously Published Design Formulas Derived and Explained

II—Derivation of Formulas

By R. P. V. MARQUARDSEN
Asst. Engineer, Chicago Terminal Improvement,
Illinois Central R. R. Co., Chicago, Ill.

In this issue the author supplies the derivations of the working design formulas given in the first part of his treatise and printed in the October issue of "Concrete," pages 27 to 29.—The Editors.

THE simplified method presented for the design of concrete circular arch dams was stated dogmatically and the design formulas were given in Part I, printed in the October issue of CONCRETE. The derivation of the formulas to be used in applying the method will now be given.

Derivation of Design Formulas

In Figure 6 is shown the center line of an arch hinged at one end and free to move at the other.

If a uniform radial loading is applied to the arch, reactions at *a* and *b* will prevent movement of the arch in a vertical direction if there is no settlement at the supports, and compressive stresses will be set up at each section of the arch. These compressive stresses will shorten the fibers of the arch and the center line will move to the position indicated by the dotted line.

A similar shortening of the arch fibers (causing a similar horizontal movement of the free end) will take place if a fall in temperature or a setting shrinkage occurs. If, however, a rise in temperature or a curing expansion takes place, there will be a lengthening of the arch fibers instead of a shortening, and the horizontal movement will be in the opposite direction.

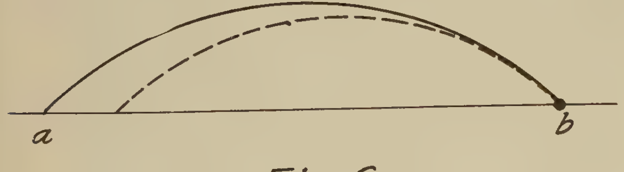


Fig. 6

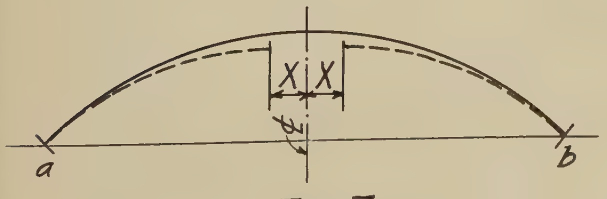


Fig. 7

If an equal settlement (along the tangent of the end sections) of the two supports takes place, such settlement will cause an increase in the span length of the arch, which is equivalent to a horizontal movement of the free end in the same direction as for a fall in temperature. A corresponding vertical movement also takes place, but this movement need not be considered, since it will be equal at both supports and will cause no increase or decrease in the span length.

Instead of considering the arch to be hinged at one end and free to move at the other, it may be regarded as being cut at the crown to allow the "crown" section of each half to move a distance away from the original vertical center line of the arch. Such movement may be considered as occurring when the shortening of the fibers caused by the uniform radial loading, the shortening or lengthening of the fibers caused by temperature changes and the setting-and-curing shrinkage or expansion, and the lengthening of the span caused by the settlement of the supports, take place. This is shown in Figure 7, the total horizontal movement of the "crown" section of each half, due to these three causes, being indicated by X.

It should be noted that the only stresses set up in the arch under this supposed movement are those caused by the uniform radial loading.

Considering a Solid Cylinder

To ascertain the magnitude of these stresses, consider first a solid cylinder subjected to a uniform radial loading, as indicated in Figure 8, in which the full line indicates the circular surface of the cylinder before the loading is applied and the dotted line the surface after the loading has been applied.

As the loading is uniform and radial, the angle between any two sections, *a-c* and *b-c*, will remain unchanged before and after the loading has been applied. It is evident also that the center of the cylinder is the only point that does not move. All other points move in a straight line toward the center, and the distance that each point moves is directly proportional to its distance from the center. For instance, if a point midway between the center and the circumference moves a distance toward the center equal to G, a point on the circumference will move a distance toward the center equal to $2G$.

From this it follows that the circular fibers of the

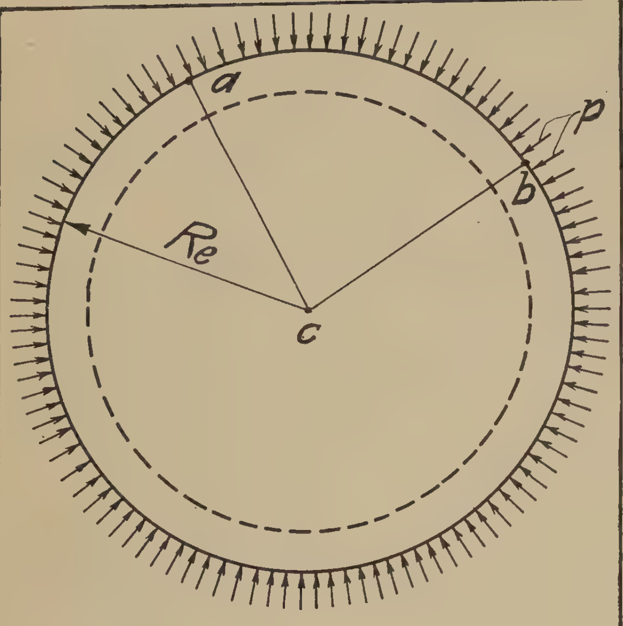


Fig. 8

cylinder (i. e., the fibers forming a circle around the center) shorten in direct proportion to their distance from the center, the total shortening of the circumferential fiber, for instance, being twice as much as the total shortening of the circular fiber located midway between the center and the circumference. But inasmuch as the length of the circumferential fiber is twice as great as the length of the circular fiber located midway between the center and the circumference, it will be seen that the unit "longitudinal" deformation of the circular fibers, and therefore also the unit compressive stress acting at right angles to their cross-sections, is equal for all fibers (no matter at what distance from the center of the cylinder they are located) and for any of their cross-sections. Other compressive stresses, which act at right angles to the "length" of the circular fibers, are set up in the cylinder by the uniform radial loading, but these compressive stresses may be disregarded for the present purpose.

To determine the magnitude of the unit stress acting at right angles to the cross-sections of the circular fibers, consider half of the cylinder removed, as illustrated in Figure 9, and the other half restrained from movement by the unit stresses acting at right angles to the exposed cross-sections of the fibers. These unit stresses are all vertical at this point and therefore resist only the vertical component of the uniform radial loading. This vertical component is equal to $2pRe$ (considering a unit length or depth of cylinder) and the unit compressive stresses resisting it are spread over a length or area equal to $2Re$.

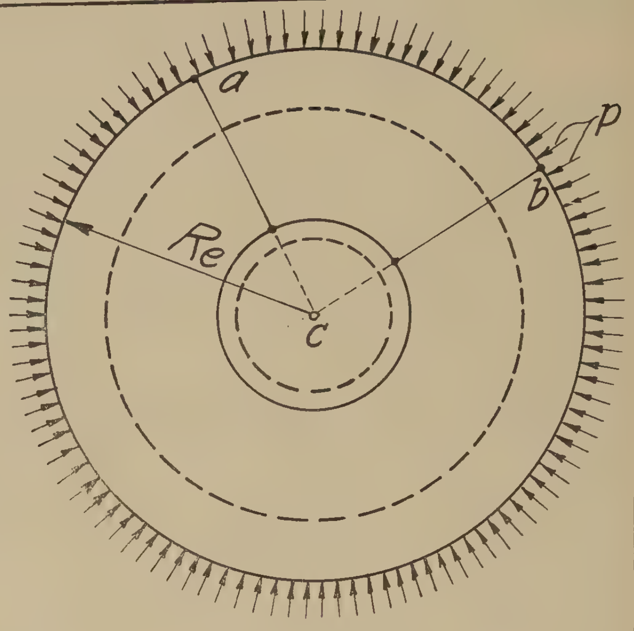


Fig. 10

The unit compressive stress is therefore equal to $2pRe \div 2Re = p$.

The Hollow Cylinder

If, instead of a solid cylinder, a hollow cylinder of an outside radius equal to the radius of the solid cylinder is subjected to the same uniform radial loading, as indicated in Figure 10, similar compressive stresses, acting at right angles to the cross-sections of the circular fibers, will be set up in the ring, but the unit stresses will be greater on account of the length or area over which they act being smaller. By referring to Figure 11 it will be seen that the unit compressive stress, s, acting at right angles to any

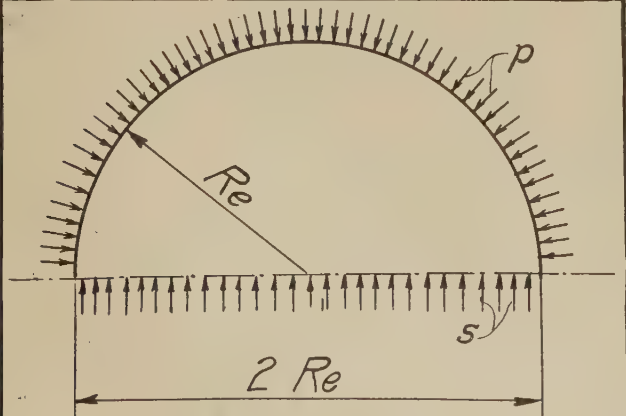


Fig. 9

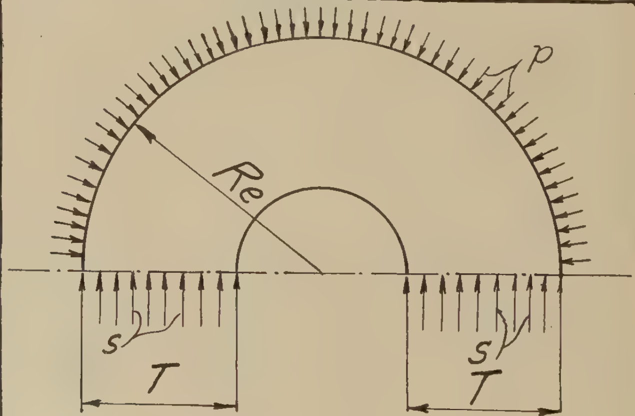


Fig. 11

cross-section of any circular fiber of a hollow cylinder, is expressed by the following formula:

$$s = p\ Re \div T \qquad (10)$$

This is the well-known cylinder formula.

The total compressive stress on any cross-section of the hollow-cylinder wall is equal to the unit compressive stress acting at right angles to the cross-sections of the circular fibers multiplied by the area of the cross-section of the cylinder wall; or, considering a cylinder of unit depth or length, the total stress P may be expressed by the following formula, which is the same as Formula (2):

$$P = sT = p\ Re \qquad (11)$$

Applying Cylinder Formulas to Arch Analysis

In Figure 12 is indicated one-half of a circular arch of uniform thickness. The arch has been cut at the crown, and under the three conditions previously mentioned the arch half shown has moved its "crown" section a horizontal distance X away from the original vertical center line of the arch. As both halves of the arch will behave in a similar manner, only one-half will need to be considered. A corresponding vertical movement of the "crown" section also has taken place, but being in the same direction for both halves it may be disregarded.

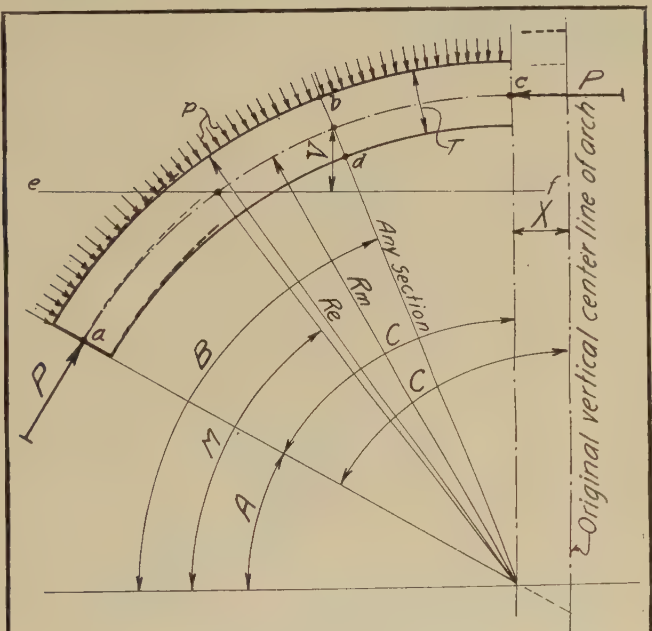


Fig. 12

The arch half under consideration is held in equilibrium by the resultant P of the compressive stresses of the "crown" section (acting at right angles to that cross-section), by the reaction at the support ($= P$, because all cross-sections of the arch are subject to the same unit stresses) acting at right angles to the end section, and by the uniform radial loading.

If we now let—

$Xp =$ the horizontal movement of the "crown" section caused by the stresses set up in the arch by the uniform radial loading,

$Xt =$ the horizontal movement of the "crown" section due to the assumed temperature change and setting-and-curing shrinkage and expansion of the concrete, and

$Xd =$ the horizontal movement of the "crown" section due to the settlement of the support along the end tangent,

the total horizontal movement of the "crown" section due to these three causes is

$$X = Xp \pm Xt + Xd \qquad (12)$$

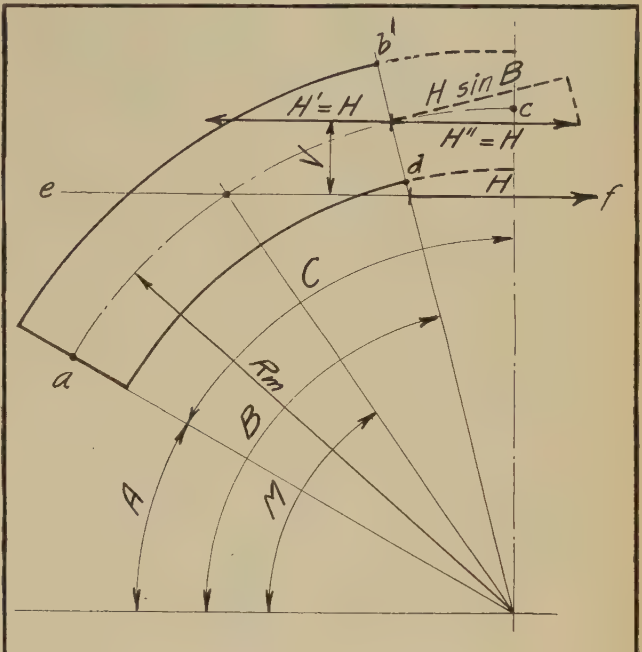


Fig. 13

The value of Xp may be found by summing up the horizontal shortening of each elementary length, ds, of the arch half under consideration. The shortening, along the arch center line, of each elementary length is equal to $s\ ds \div E$ or $P\ ds \div ET$, and the corresponding horizontal shortening will be this distance multiplied by the sine of the angle that the section makes with the horizontal.

The length Xp, therefore, is expressed by the following formula:

$$Xp = \int_a^c \frac{P \sin B}{ET}\, ds$$

$$= \int_{B=A}^{B=A+C} \frac{Rm\ P \sin B}{ET}\, dB$$

$$= \frac{Rm\ P}{ET} \int_{B=A}^{B=A+C} \sin B\, dB$$

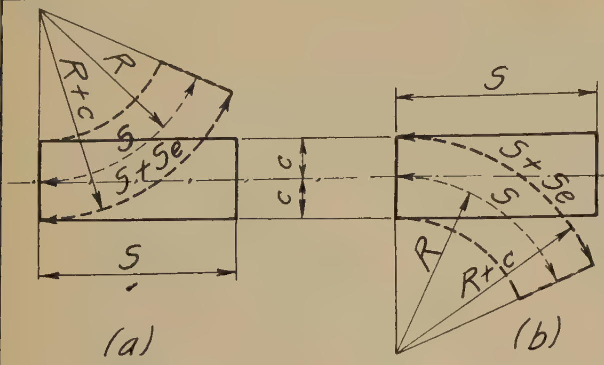
$$Xp = \frac{Rm\ P}{ET} \sin C \qquad (13)$$

The value of Xt may be found in a similar manner, the shortening, along the center line of the arch, of each elementary length, ds, being equal to $c\ t\ ds$.

The length Xt, therefore, is

$$Xt = \int_a^c c\ t \sin B\, ds$$

$$Xt = Rm\ c\ t \sin C \qquad (14)$$



$$S+Se=(1+e)S$$

$$R+c=\left(1+\frac{c}{R}\right)R$$

$$f = Mc \div I$$

$$e=f\div E=\frac{Mc}{IE}$$

$$\text{Change in Angle} = \frac{S}{R}=\frac{(1+e)S}{\left(1+\frac{c}{R}\right)R}$$

$$\text{from which} \quad 1+e=1+\frac{c}{R}$$

$$\text{or} \quad e=\frac{c}{R}=\frac{Mc}{IE}$$

$$\text{or} \quad \frac{1}{R}=\frac{M}{IE}$$

$$\text{or} \quad \frac{S}{R}=\frac{MS}{IE}=\text{change in angle}$$

Fig. 14

The value of *Xd*, as is self-evident, may be found by the following formula:

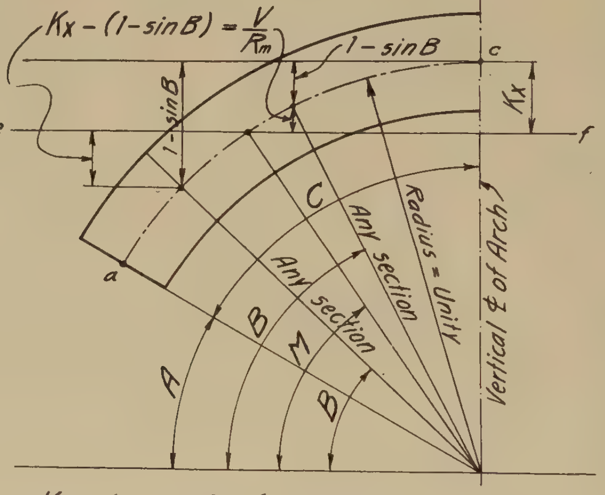
Xd = *D cos C* ....(15)

Inasmuch, however, as an arch is not cut at the crown, no horizontal movement of the "crown" section actually takes place (although it can and does move in a vertical plane) and it is evident, therefore, if the arch is fixed at both ends, that other stresses, in addition to those heretofore considered, are set up in the arch ring by the three causes mentioned. These additional stresses are equal to those produced by the application of a force such as would be necessary to bring the "crown" section back to the original vertical center line of the arch, without changing the angle *C* between the "crown" section and the end section. The force must act in a horizontal direction (as no attention needs be paid to the vertical movement) toward the original vertical center line of the arch; and, for reasons that will be made evident later, its line of action must lie somewhere between the crown and the end section. Such force, in addition to causing the arch fibers to lengthen, will also cause bending in the arch.

Assuming for the time being that the line of action has been established and calling the force *H* and the perpendicular distance between the line of action and the center of any section under consideration *V*, the bending moment at the section will be equal to *VH*. The total direct tensile stress (causing the arch fibers to lengthen) at, and normal to, any section is equal to *H sin B*. All of this will be understood more readily by referring to Figure 13, in which the force *H* is shown acting on a section *b* — *d*. At the center of the section two forces, *H′* and *H″*, are assumed to be applied. Each is equal in magnitude (and each equal to *H*) but opposite in direction, and both are acting in a line parallel to the line of action of *H*. There is now acting on the section a couple of *H′* — *H*, causing bending, whose moment is *VH′* or *VH*, and a single force *H″* (= *H*), which is applied at the center of the section. The component of the force, normal to the section, is equal to *H sin B* and produces equal unit tensile stresses in all fibers. The component parallel to the section is equal to *H cos B* and produces shearing stresses.

Before proceeding further it will be desirable to discuss the change in angles between sections of a beam that occurs when the beam is subjected to bending.

Figure 14 illustrates a straight beam of length *S*. At (*a*), in dotted lines, the beam is shown bent due to positive bending moments, and at (*b*) it is shown bent due to negative bending moments. Assuming that the bending moment at each section has the same numerical value, the center line of the bent beam, in both cases, will be an arc of a circle, and the change in angle between the two end sections of the beam will be equal to *S* ÷ *R* in each case (though, of course, of opposite direction) inasmuch as the original angle between the two end sections is equal to zero.



$$Kx = 1-\sin M \quad (= \text{a constan.})$$

$$\frac{V}{R_m}=Kx-(1-\sin B)$$

$$-\int_{B=A}^{B=M}\frac{V}{R_m}\,dB=-\int_{B=A}^{B=M}(Kx-1+\sin B)\,dB$$

$$=-\left[(Kx-1)M-\cos M-(Kx-1)A+\cos A\right] \cdots\cdots (a)$$

$$\int_{B=M}^{B=A+C}\frac{V}{R_m}\,dB=\int_{B=M}^{B=A+C}(Kx-1+\sin B)\,dB$$

$$=(Kx-1)(A+C)-\cos(A+C)-(Kx-1)M+\cos M \cdots\cdots (b)$$

Equating (a) and (b) and solving for Kx :

$$Kx = 1-\frac{\sin C}{C} \cdots\cdots\cdots\cdots\cdots (c)$$

Fig. 15

This change in angle between the two end sections is, as may be seen by referring to Figure 14, also equal to the product of the bending moment M and the length S, divided by the product of the moment of inertia I of the beam section and the modulus of elasticity E of the beam material.

If the bending moment differs at each section of the beam (which is generally the case), the change in angle between the two end sections is equal to the algebraic sum of the change in angle between adjacent elementary sections throughout the length S, the length of each elementary section being equal to an infinitesimal distance ds. Similarly the change in angle between any two sections of the beam is equal to the algebraic sum of the change in angle between adjacent elementary sections throughout the portion of the length S that is located between the two sections under consideration.

The foregoing discussion is based on a beam that is straight before bending. For a curved beam the same formulas may be used without appreciable error.

Returning now to the arch half in Figure 12 and remembering that the bending moment at any section is equal to VH (V being a variable and H a constant), we find, inasmuch as an arch of unit depth is being considered and the moment of inertia therefore is equal to $T^3 \div 12$, that the total change in angle between the end section and the "crown" section, $\triangle C$, may be expressed by the following formula:

$$\triangle C = \int_{a}^{c} \frac{12\,V\,H}{T^3\,E}\,ds$$

$$= \int_{B=A}^{B=A+C} \frac{12\,Rm\,V\,H}{T^3\,E}\,dB$$

$$= \int_{B=A}^{B=A+C} \frac{12\,Rm^2\,V\,H}{T^3\,E\,Rm}\,dB$$

$$\triangle C = \frac{12\,Rm^2\,H}{T^3\,E} \int_{B=A}^{B=A+C} \frac{V}{Rm}\,dB \quad \text{......(16)}$$

But this change in angle must equal zero, as the angle C must not change. The horizontal line along which H acts must be so located that—

$$-\int_{B=A}^{B=M} \frac{V}{Rm}\,dB = \int_{B=M}^{B=A+C} \frac{V}{Rm}\,dB$$

because the sections whose centers fall above this line are subjected to positive bending moments; and the sections whose centers fall below the line, to negative bending moments.

This will be accomplished when it is located a vertical distance below the arch center line, at the crown, equal to $Kx\,Rm$, in which Kx has the value given by Formula (6). The derivation of this formula is indicated in Figure 15.

Although no change occurs in the angle between the end section and the "crown" section when the force H acts along the horizontal line established as outlined above, the "crown" section, due to the bending action as well as to the direct action of the force H, nevertheless will move in a vertical and in a horizontal direction. The vertical movement of course, may be disregarded.

The horizontal movement due to the direct action of the force H may be found in much the same manner as the horizontal movement due to the compressive stress P acting along the center line of the arch, the only difference being that P acts normal to each section whereas H acts at a different angle for each section. As previously shown, the component of H normal to any section is equal to $H \sin B$.

Indicating by Xh the horizontal movement of the "crown" section, due to the direct action of H, we find, by referring to formula 13, that

$$Xh = \int_{a}^{c} \frac{H \sin B \sin B}{E\,T}\,ds$$

$$= \int_{B=A}^{B=A+C} \frac{Rm\,H \sin^2 B}{E\,T}\,dB$$

$$= \frac{Rm\,H}{E\,T} \int_{B=A}^{B=A+C} \sin^2 B\,dB$$

$$Xh = \frac{Rm\,H}{E\,T}\,Ky \quad \text{......(17)}$$

in which Ky has the value given by Formula (7).

The horizontal movement, Xb, of the "crown" section due to the bending action of the force H is equal to the algebraic sum of the horizontal movements of the "crown" section due to the bending at each section of the arch half.

To ascertain the horizontal movement, dXb, of the "crown" section due to the bending at any section, consider Figure 16, in which only the effect of the bending at a single section is shown. At (*a*) is shown the effect due to a positive bending moment and at (*b*) the effect due to a negative bending moment. The solid curved line *a-b* shows the position of the center line of the arch half *before* bending takes place and the dotted curved line *a-c* the position *after* bending takes place. The center of the "crown" section therefore describes an arc *b-c* when the arch is bent. The corresponding horizontal movement dXb is equal to the distance *b-d*. The length of the curve *b-c* is of course equal to the change in angle at *a* multiplied by U, the straight distance between points *a* and *b*. To evaluate the distance *b-d* an approximation is introduced, which should be noted carefully. As the angle *b-a-c* is very small (the diagram is of course greatly exaggerated) it is assumed that the center of the "crown" section, instead of prescribing the arc *b-c*, will make a straight line *b-f*, equal in length to arc *b-c* and normal to the straight line *a-b*. In other words, the horizontal distance *b-d* is assumed equal to *b-e*. As triangle *a-b-g* and *b-f-e* are similar, it follows that—

b-e- : *b-f* : : *a-g* : *a-b*

or—

dXb : change in angle at *a* times U : : Y : U

From this, remembering that the change in angle at any section is equal to $12\,V\,H\,ds \div T^3\,E$, it will be seen that the horizontal movement, dXb, of the "crown" section due to the bending moment at any section is equal to $12\,V\,H\,Y\,ds \div T^3\,E$.

The total horizontal movement, Xb, (toward the original vertical center line of the arch) of the "crown" section due to the bending action of the force H is, therefore, (referring again to Figure 12) expressed by the following formula:

$$Xb = \int_{a}^{c} \frac{12\, V\, H\, Y}{T^3\, E}\, ds$$

$$= \int_{B=A}^{B=A+C} \frac{12\, Rm\, V\, H\, Y}{T^3\, E}\, dB$$

$$= \int_{B=A}^{B=A+C} \frac{12\, Rm^3\, V\, H\, Y}{T^3\, E\, Rm^2}\, dB$$

$$= \frac{12\, Rm^3\, H}{T^3\, E} \int_{B=A}^{B=A+C} \frac{V\, Y}{Rm^2}\, dB$$

$$= \frac{12\, Rm^3\, H}{T^3\, E} \int_{B=A}^{B=A+C} (Kx - 1 + \sin B)\, (1 - \sin B)\, dB$$

$$Xb = \frac{Rm^3\, H}{T^3\, E}\, Kz \qquad \text{(18)}$$

in which Kz has the numerical value given by Formula (8). The constant Kx is the perpendicular distance between the horizontal line along which the force H acts and the center of the "crown" section divided by Rm; or, in other words, the value of Kx is as given by Formula (6).

The total horizontal movement of the "crown" section due to the direct and bending action of the force H must equal the total horizontal movement of the "crown" section due to the action of the uniform radial loading, the temperature and shrinkage changes, and the support settlement; or—

$$Xh + Xb = Xp \pm Xt + Xd \qquad \text{(19)}$$

Substituting in this formula the value for Xh, Xb, Xp, Xt, and Xd, given by formulas (17), (18), (13), (14) and (15), respectively, and solving for H, we have—

$$H = \frac{(P \pm c\, t\, E\, T)\, \sin C + (D\, E\, T \div Rm)\, \cos C}{Ky + \left[\dfrac{Rm}{T}\right]^2 Kz} \qquad \text{(20)}$$

Formula (20), it will be seen, is identical with Formula (3).

Formula (1) is merely a variant of the well-known formula for finding the unit fiber stress when the section is subject to direct and bending action at the same time. Thus we have—

$$f = \frac{N}{A} \pm \frac{Mc}{I} \qquad \text{(a)}$$

in which, as we are considering an arch of unit depth,

$N = P - H \sin B$ ....(b)

$A = T$ ....(c)

$M = V\, H$ ....(d)

$c = T \div 2$ ....(e)

$I = T^3 \div 12$ ....(f)

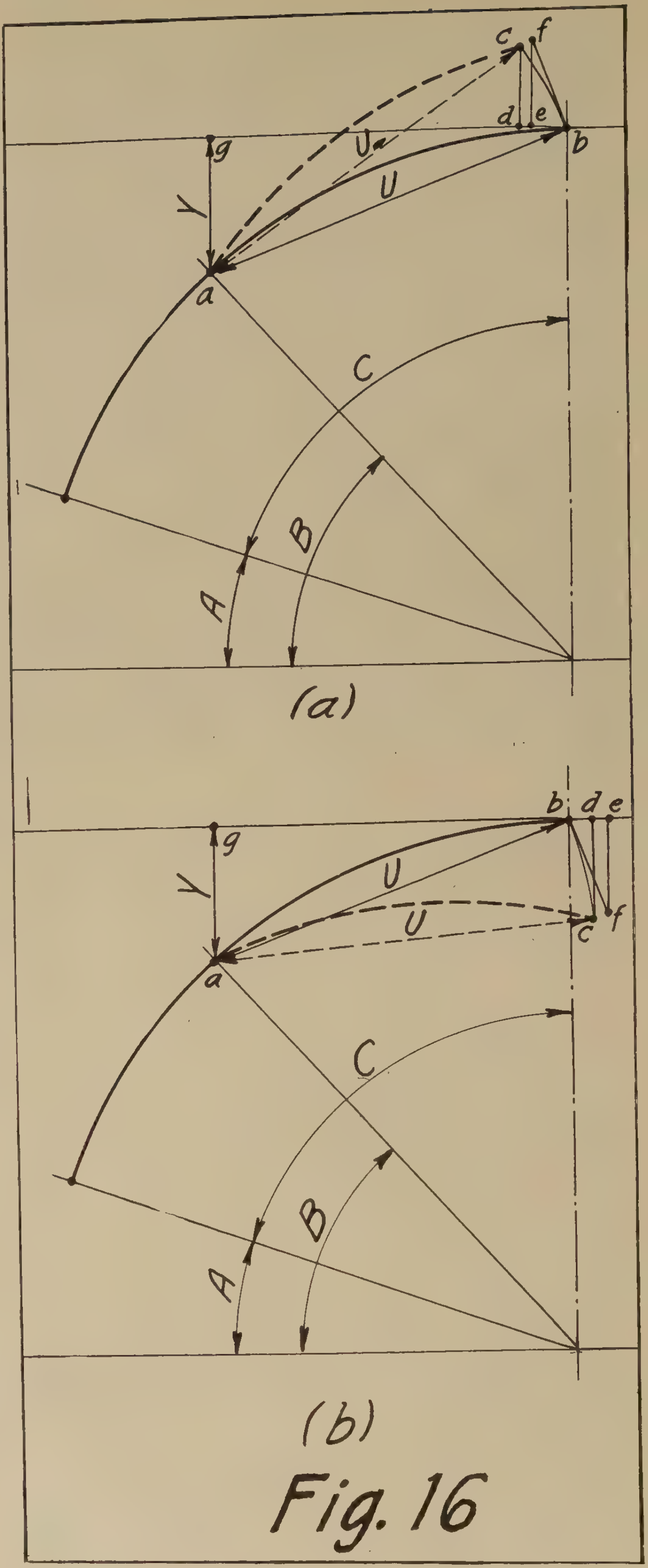


Fig. 16

Substituting these values for those given in formula (a), we have—

$$f = \frac{P - H \sin B}{T} \pm \frac{6\, V\, H}{T^2} \qquad \text{(21)}$$

Formula (21), written in this form, is identical with Formula (1).

Formula (9) is derived from the usual shear formula for homogeneous rectangular beams, the total shear, as previously indicated, being equal to $H \cos B$.

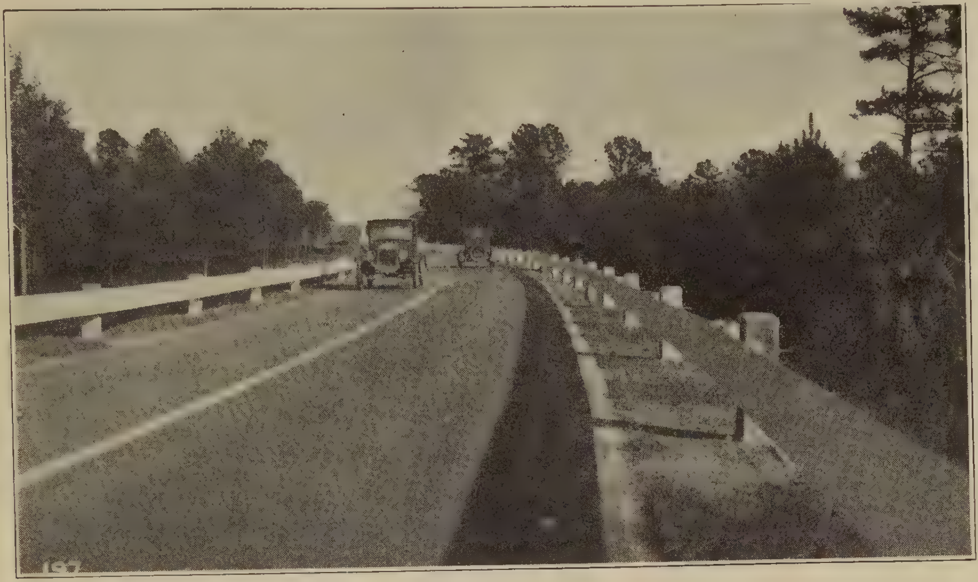
Resilient Connection Between Concrete Posts and Highway Guard Rail

A new type of highway guard rail attached by spring connections to concrete posts has recently come into use on important highways in Georgia and other southeastern states. It requires more than 300 concrete posts for a mile of rail.

The design of the guard rail is such that it serves not only as a marker defining the edge of a road, but also acts as a bumper or buffer to divert traffic back into the resilience in the rail. Cars hitting it have some of the impact absorbed and are turned back into the highway.

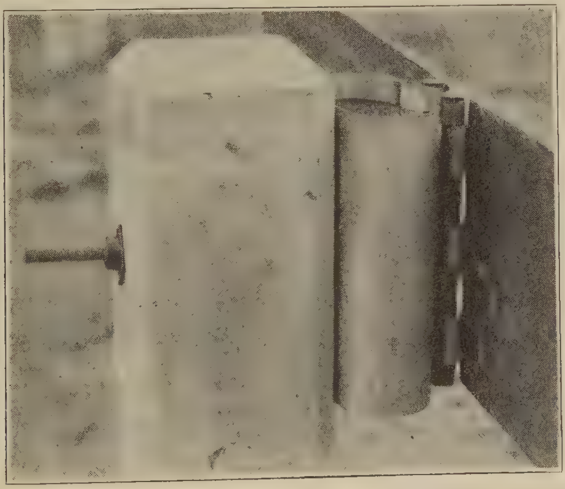
The face of the rail is set out about 6 in. from the concrete posts on which it is supported. This is accomplished by means of a heavy steel combination spring support. This 6-in. offset reduces the likelihood that a vehicle running into the guard rail will strike one of the posts. The spring connector and support which holds the rail away from the posts also serves as a buffer, absorbing a good deal of the initial shock when a car strikes the rail. Only one bolt is used to hold the rail to the posts.

Because of the method of attachment of the rails to the spring through double hinged joints, it is claimed that shocks are not all taken up on one of the supporting springs but distributed in both directions up and down the line of the rail to several spring supports and posts. The number to which it is distributed depends on the intensity of the shock, and the effect is thus to minimize the shock at any one post.



New type of highway guard rail attached to concrete posts has resilient connection. The rail is at the height of an automobile hub

highway. It is a valuable safety feature for motorists at bridges, culverts and similar hazards. The rail itself, being a flat piece of 12-in. strip steel, presents an unbroken surface for impact. Cars striking its face are not caught and diverted, but easily slide along and back into the road.



Spring interposed between concrete post and strip steel railing supplies an unusually resilient connection

Spring Connection Between Railing and Post

A spring connection that is an essential feature of this guard rail adds a further safety factor, for it provides

Details of Concrete Posts

The concrete posts are set on 16-ft. intervals and usually stand about 28 in. high. They are long enough to permit attachment of the guard rail at hub and running-board height, and extend deep enough into the ground to provide solid anchorage. Most of the posts are 6 ft. long and extend 3 ft. and 8 in. into the ground.

For most conditions a concrete post 8 in. square will be found suitable for use with this guard rail. It should be reinforced with four ¾-in. steel bars, one in each corner. The reinforcement should be covered with at least 1 in. of concrete.

One hole in each concrete post, to accommodate a ¾-in. bolt, is required at the point where the guard rail is to be attached. This hole should be 8 in. from the top of the post.

Suggests Rebuilding Parthenon in Concrete

The suggestion that rather than attempt to restore the Parthenon at Athens, the whole structure be demolished and rebuilt entirely in concrete, has been made by O. E. Bodington, British structural engineer.

HOW TO DO IT

Questions and Answers
Consultation and Comment

A department devoted to the solution of problems encountered in concrete work. Readers are welcome to add to or improve upon the suggestions printed and to submit their views for possible publication.

How Gypsum Content May Affect Soundness

Have you published any articles recently in Concrete *on the subject of a low gypsum content producing a high expansion in portland cement?—B. M. N., Chinnor, Oxfordshire, England.*

In an indirect way low gypsum content might lead to unsoundness in cement, as explained by the late Richard K. Meade, an American consulting engineer and an authoritative writer on the manufacture of portland cement. This subject is touched on in the third edition of his volume on "Portland Cement."

First, he points out on page 630, where he discusses unsoundness of cement because of expansion, that "all authorities seem to agree that the chief cause [of expansion] is the presence of free or unstable lime over and above a certain limit. This free lime slakes *after* the cement itself has hardened or set, causing the test piece to warp and check from the expansion set up by the slaking. The object of all tests for soundness is, therefore, to ascertain if the maximum of free lime that may safely be present has been exceeded."

Then, on page 633, Meade discusses specifically the purpose and effect of the addition of gypsum. Here he says: "Pats allowed to harden in steam or hot water will often pass the boiling test where pats hardened in air will not. It must be remembered that checking is caused by slaking [of free lime] *after* the pats are fully hardened. If they are placed in steam to harden, the moist air merely accelerates the slaking of lime, doing the work before the pat hardens, just as heat hastens any chemical action. The addition of sulphates, either as gypsum or plaster of Paris, aids the cement in standing the boiling test, probably because it delays the set until after the lime has slaked."

Thus a logical explanation is offered as to why low gypsum content may be the indirect cause of expansion and consequent checking. Since gypsum tends to delay the set until after the free lime has slaked, it logically follows that a low gypsum content will permit an earlier set, as a result of which the pat of cement may harden before the lime has slaked. Then, when slaking occurs, expansion and checking are the likely results.

Pumping Mixed Concrete

I am told that there is a pump or gun on the market that pumps mixed concrete for a distance of 100 ft. or more. Can you give me some information about it?—B. N., Chicago, Ill.

An illustrated article describing the repair of damaged concrete work in the substructure of the New York Municipal Baths on Coney Island was printed on page 46 of the July (1930) issue of Concrete. Mention is made of the use of a concrete pump or gun such as you probably have in mind. The gun itself is illustrated on page 57 of the same issue of Concrete.

On this repair work it pumped a 1:1:2 mixture. It is said that the coarse aggregate should not be larger than ½ in.

Hard and Dustless Concrete Floors

I have 43,000 sq. ft. of concrete floor to lay in a factory building. What is the best way to make a hard-surfaced floor that will not dust?—R. P. G., North Girard, Pa.

The following articles published in recent issues of Concrete will answer your question in a thorough manner:

(1) May, 1930, pp. 33-34—Good Practice in Concrete Floor Finish.

(2) June, 1930, pp. 31-33—Manipulation of Concrete Floor Finish—Illustrated.

(3) June, 1930, p. 57—Overcoming Dusting of Concrete Floors.

(4) August, 1930, pp. 37-38—Recommended Practice for Heavy Duty Floor Finish.

The first of the above articles describes the proper procedure to follow in placing and finishing a concrete floor for heavy duty in locations such as industrial buildings. The second article describes the placing and finishing of heavy duty floors, the procedure being illustrated by close-up views of the various steps in the process. The fourth article is a reprint of the American Concrete Institute's recommended practice, while the third article contains instructions for overcoming dusting on existing concrete floors where dusting has developed because of improper construction or finishing.

Especially careful study of the first, second and fourth of the articles listed above will be well worth while, for the working procedure described is a definite departure from former practice. Excessive troweling, the use of too much mixing water and the use of too high a percentage of fine sand particles are some of the former practices that are condemned.

Molds for Ornamental Concrete Work

Where can I get molds for casting ornamental concrete work such as urns, vases, flower boxes and other garden furniture? I would also like to have a list of good books on cast stone.—P. P., Long Island, N. Y.

Names and addresses of manufacturers of molds for ornamental cast stone work may be found in the "Classified Index of Things Advertised," on pages 7 and 9 of each issue of Concrete. The list has been sent.

A revised edition of H. L. Childe's "Manufacture and Uses of Concrete Products and Cast Stone" is scheduled for publication soon. You will be notified when copies are available.

Concrete for the Builder

A Department Devoted to the Promotion and Practical Construction Details of Concrete Work

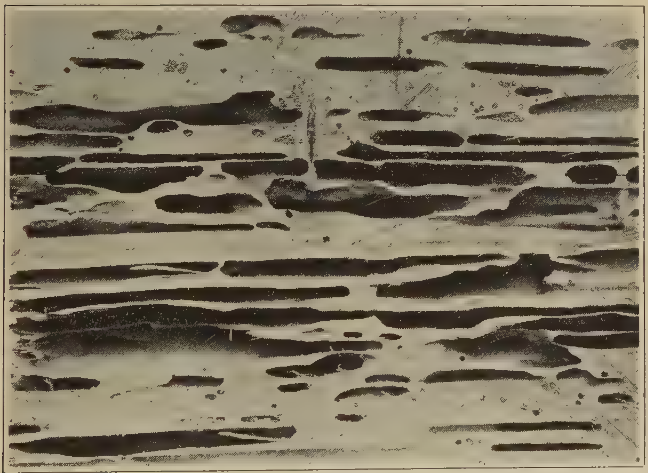
Concrete Construction Bars Termites From Old or New Buildings

Nearly All Sections of Country Infested—Eliminating Termites from Old Buildings Is Good Specialty for Concrete Builder—Procedure Followed with Old and New Buildings—Concrete First Floors Are Effective Barrier

By T. A. DAY

PEOPLE in the United States spend millions of dollars each year to feed insect pests, including termites, which damage wooden structures.

The subterranean or ground-nesting termite, sometimes called the "white ant," does most of the damage. The non-subterranean termite also is active, but the damage done by it is small compared to that caused by its subterranean cousins. The latter are widely distributed in this country.



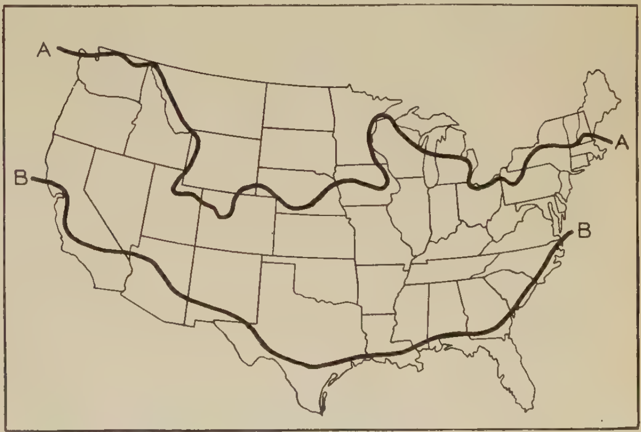
Illustrating damage to timber by dry-wood termites. This wood had a sound appearance except that when closely inspected a few holes about the size of buckshot could be seen. To determine the amount of damage done, the timber was ripped as shown, revealing the inside work of the termites

How Termites Operate

Termites are insects which feed upon wood. Wood joists, wood studding, columns, stairways and even pieces of furniture are not spared in their attacks. Termites live in colonies headed by a king and queen. The queen lays as many as 80,000 eggs a day or about one every second during the egg laying time. Besides the "royal pair," there are thousands of "workers" or "white ants." It is this group that does the damage. The colony also has a number of "ant soldiers" always on guard to protect it from attack by its enemies. In such well arranged organizations termites sometimes live to be 20 or 30 years old and at the rate at which they multiply it is easy to understand why they are a menace to property owners.

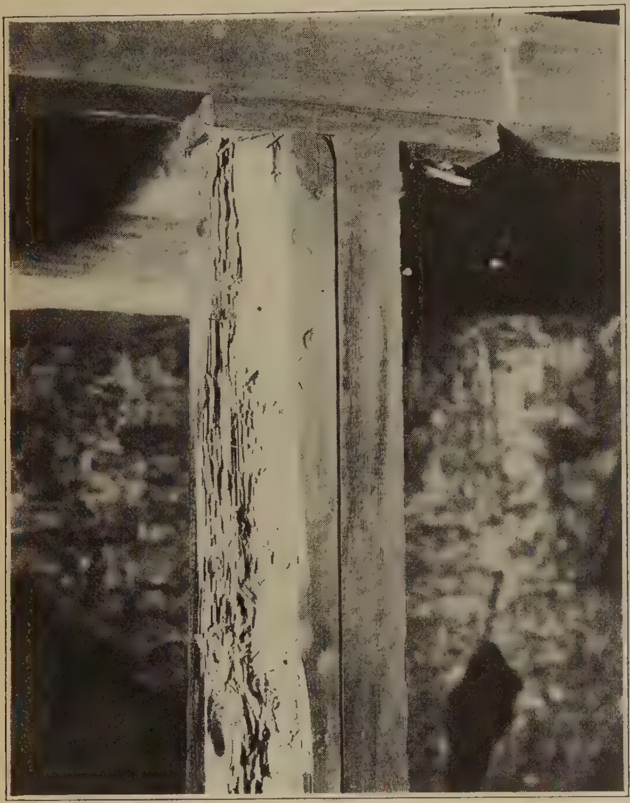
Insects Spread Over Wide Area

The insect is found as far north as Washington and Oregon on the west Coast, Wisconsin and Michigan in the central states, and as far north as Maine on the Atlantic Coast. The termite is most active in the southern states. In Shreveport, Louisiana, for example, 76 out of 80 buildings inspected were found to be infested. Government reports say that the infested area is growing larger each year. Unless the insect is controlled, this area may eventually know no bounds. In the tropical and sub-tropical countries termites are especially active. Cuba with its



Map showing distribution of termites in the United States. Subterranean termites have advanced as far north as the line "A" and dry-wood termites have been discovered as far north as the line "B" hot, moist climate provides particularly favorable conditions for the destructive termite, and Cubans have to fight a constant battle against them to hold destruction at a minimum.

Termites originally lived entirely on wood in the forests, eating into dead logs and fallen trees or branches, but since man has cleared large areas, depriving them of their natural food and shelter, they have been forced to seek these essentials in the wood of houses and other structures. They gnaw into wood members, leaving only a shell that covers a honeycombed interior which has little strength.



An example of termite damage; almost one-half of this post has been destroyed and the condition of the post was hidden from the eye by a thin shell of wood. The white line on the beam shows the path of termites to the floor above

Damage Is Concealed

Home owners usually are not aware of the damage that is being done until a stairway fails or the piano plunges through the floor. Carpenters often discover, when remodeling old buildings, that termite damage is so extensive that the structure is not worth repairing.

Taking Advantage of a Life Habit

Fortunately, termites have one life habit which makes it possible to control them—they must maintain contact with moist earth. The "workers" travel back and forth from a building to their nests in the ground. When they are required to go on the outside wall of a structure they build covered passageways to protect themselves from exposure to the sun. Continuous exposure kills them and, therefore, buildings that are built so that the termites cannot maintain contact with the earth are proof against their attacks.

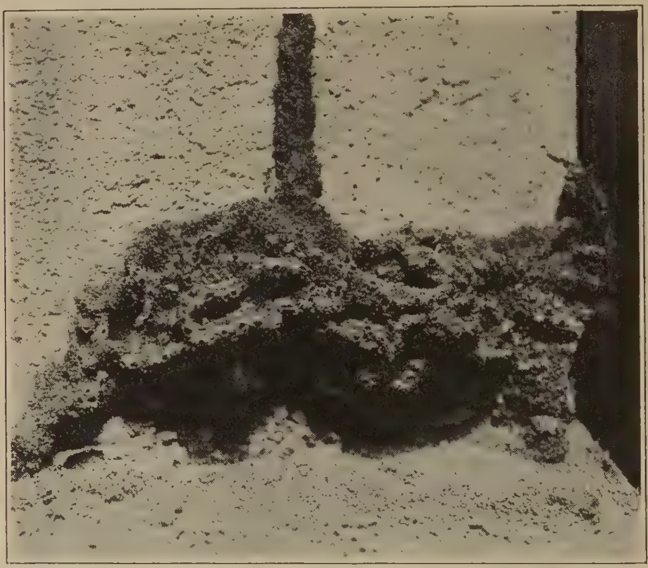
It is evident from the foregoing that termite-proof construction is desirable in practically all sections of the country.

That concrete is the building material best adapted for termite-proof construction is generally recognized. In many termite-infested sections of the country concrete contractors are developing considerable business constructing new buildings of concrete or using this material to modernize old buildings which have been damaged.

Barring Out Termites with Concrete

Where concrete is used to modernize an old building infested with termites—a house, for example—the object is to insulate the building against the pests. Insulating a wooden building against termites includes laying a smooth, dense concrete floor over the entire basement area and the construction of a concrete wall which is carried at least 18 inches above grade. To further insulate buildings against termites, concrete is often used to replace all wood posts and partitions in the basement.

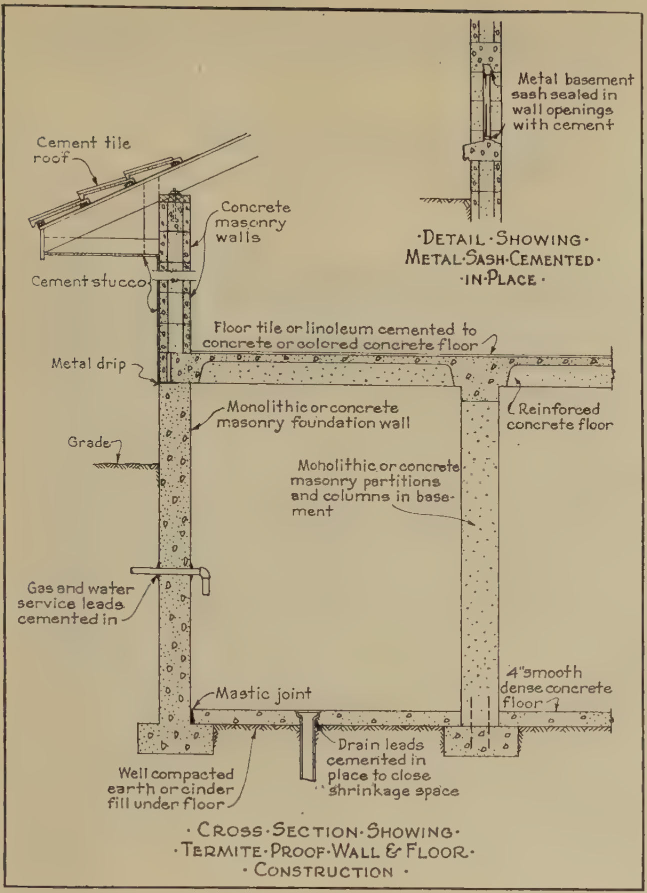
Gas, water and sewer lines entering a building through the floor or walls should be sealed with portland cement mortar. Shrinkage cracks which sometimes form around piping provide a passageway through which termites can invade a building. Cracks, if any, in the basement walls also are sealed with cement mortar. Wood window frames are replaced with steel frames and are cemented in place, care being taken not to leave openings through which the insects can pass. This is especially important, as basement windows usually are a short distance above the earth, and if they are of wood or if there are openings around them, termites have no difficulty in entering the basement, thence working to other parts of the building.



Shelter tubes of subterranean termites constructed on walls in effort to reach wood above

Plastering Old Masonry Walls

If the basement walls are of masonry construction, a concrete cap at least 1 inch thick is placed over the top of the entire wall, and often a copper shield is built into the wall above the cap. This concrete cap prevents the termites from coming up through the core spaces in the masonry or through open joints in the wall. The metal shield, which extends 2 inches outside of the wall, prevents termites from continuing their covered passageways along the outside of the foundation wall to the superstructure. Then if the basement walls are of masonry construction, a final protective measure is to cover the walls inside and out with cement plaster. This eliminates

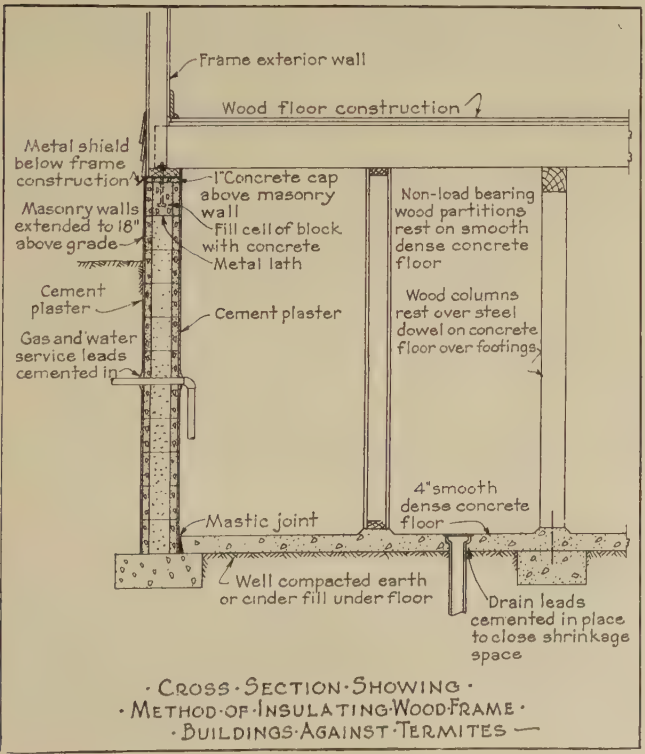

Cement tile roof
Concrete masonry walls
Cement stucco
Metal basement sash sealed in wall openings with cement
·Detail·Showing·Metal·Sash·Cemented·in·Place·
Floor tile or linoleum cemented to concrete or colored concrete floor
Metal drip
Monolithic or concrete masonry foundation wall
Reinforced concrete floor
Grade
Monolithic or concrete masonry partitions and columns in basement
Gas and water service leads cemented in
4" smooth dense concrete floor
Mastic joint
Drain leads cemented in place to close shrinkage space
Well compacted earth or cinder fill under floor

·Cross·Section·Showing·Termite·Proof·Wall & Floor·Construction·

any chance of the termites working their way through mortar joints.

Accessory Parts of Old Buildings Replaced

There are other parts of the building which are open to termite attack. They can gnaw their way through porches, steps, posts and, in fact, all exterior parts of the building which are of wood and in contact with or within several inches of the earth. It is well to replace these with concrete.


Frame exterior wall
Wood floor construction
Metal shield below frame construction
1" Concrete cap above masonry wall
Masonry walls extended to 18" above grade
Fill cell of block with concrete
Metal lath
Non-load bearing wood partitions rest on smooth dense concrete floor
Cement plaster
Cement plaster
Wood columns rest over steel dowel on concrete floor over footings
Gas and water service leads cemented in
4" smooth dense concrete floor
Mastic joint
Well compacted earth or cinder fill under floor
Drain leads cemented in place to close shrinkage space

·Cross·Section·Showing·Method·of·Insulating·Wood·Frame·Buildings·Against·Termites —

New buildings are made termite-proof by means of concrete floors and basement walls of concrete as described for insulating an old building. The same precautions must be taken to seal all service leads and to see that door and window openings offer no means for the termites to get into the building.

Concrete Floors an Effective Barrier

For complete termite insulation it also is desirable to build the first floor of reinforced concrete. This provides firesafe as well as termite-proof construction. In Cuba, where termites are prevalent, floors in nearly all buildings are built of concrete covered with attractive tiling or colored concrete toppings. When wood surfaces are desired, the flooring may be nailed to sleepers embedded in the concrete or to sleepers attached to the concrete by clips. If flooring materials like linoleum or rubber are desired, these can be cemented to the concrete. Or the concrete floor itself may be colored and marked off in various designs. Whatever the surface treatment, the concrete structural floor provides protection against termite attack, and equal protection is given interior woodwork and furniture.

Termite-proof construction in which concrete has been used for the basement floor, the foundation walls and the first floor

Dr. Snyder, of the U. S. Bureau of Entomology, who has studied methods for making buildings termite-proof, says that about 2 per cent of the first cost covers the additional expense necessary for termite-proof construction. "Precaution," he states, "is much simpler and cheaper than remedial measures." It is his opinion that city building codes should be amended with regulations which would require all new structures to be made termite-proof when built.

Color in Concrete

Only finely ground pure mineral pigments will produce satisfactory color in portland cement concrete exposed to weathering.

Fixtures and Concrete Masonry

A simple manner of providing for downspout brackets, telephone and electric service wires as well as other fixtures to be fastened to walls of concrete masonry is to place short lengths of small lead pipe in the mortar joints into which expansion bolts may later be inserted.

Shuffleboard Captures Small Northern Community

Six Courts in City Park and Five Private Courts Kept Busy—Popularity Gains Momentum as Season Advances—Game Played by People of All Ages—Construction and Cost Data

By E. M. HOWENSTEIN
Secretary of Park Board, Nappanee, Indiana

An illustrated article in the March (1930) issue of "Concrete," pages 56 and 57, describes the construction of concrete shuffleboard courts. Details of a standard court, including all dimensions, are given. Another drawing contains the details and dimensions of the cues and discs employed in playing the game.

In the article now presented the author describes how the game met with immediate popularity in a northern community, and how the interest in the game has been gaining momentum.

Concrete builders should bring this story to the attention of local park boards, to the management of Y. M. C. A.'s and similar organizations, and to owners of places of amusement, both indoor and outdoor.—The Editors.

WHEN the members of the park board of Nappanee, Indiana, first considered the question of building concrete shuffleboard courts in the city park there was some hesitation because of the fear that the popularity of the game might be short-lived. On the other hand, local citizens who had spent part of the previous winter in Florida brought back reports indicating that the game was much more than a temporary craze. There was the further thought that the courts would not cost much, since their construction involved little that is not encountered as a regular thing by builders of concrete sidewalks.

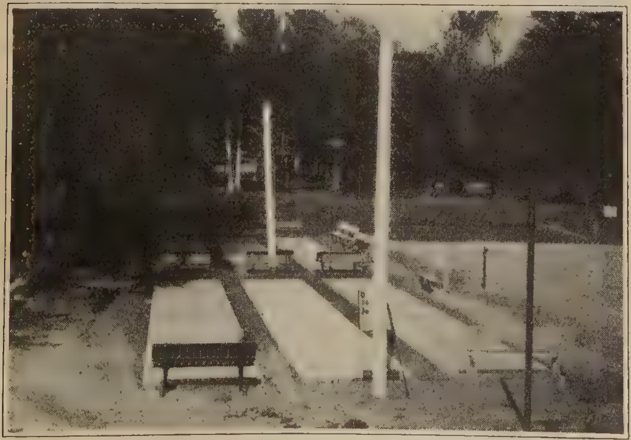


Figure 1. Clean-cut concrete work in group of six shuffleboard courts

Game Meets with Instant Popularity

Accordingly, the members of the board decided to build three courts on a site adjoining the municipal tennis courts and near the children's playground. These were built in early June of this year.

The word "instant" is a much abused word; but it is not necessary to stretch the imagination to say that the game of shuffleboard met with instant popularity in our little city of 3,000 population. In less than two weeks the three courts were completely swamped, so we built three more in July, making six in all. Even then the courts were soon overtaxed, and we were compelled to place a 3-game limit on the players in order that all might have a chance.

Interest Gains Momentum

The interest in the game kept growing and the courts were kept busy well into the fall months. This fact is proved by one of the illustrations, taken on October 12th, when the courts were crowded almost as much as in the summer months, when frequently one might see from 100 to 150 people either playing or awaiting their turn.

It is especially gratifying to know that the game is as popular with women and girls as with men and boys. Mothers leave their children in the playground nearby and enjoy a few games meanwhile. Office and factory people come out in the evenings and on Sundays. People of all ages play on the courts, for the game is neither too vigorous for the elderly people nor lacking in excitement for the young. It is one of the best means available to induce the public to use the parks.

Soon the game became so popular that on many nights playing was kept up until 4 o'clock in the morning. Naturally this led to complaints from residents in the vicinity of the courts, so the difficulty was adjusted by installing an automatic cut-out which shut off the lights at 11:30.

Interest was further stimulated by means of a tournament on Labor Day, in which several hundred players participated.

No Charge for Playing

No charge is made for the use of the courts, and strangers are welcome no less than townspeople. The decision to make no charge was founded on several reasons. As previously intimated, the main purpose of the park board was to provide an attraction that would induce the people to use the park for the upkeep of which they are paying. Furthermore, the cost of the courts and equipment was so little that it seemed best to permit their free use to all comers.

No extra attendant has been found necessary. The regular caretaker of the park comes around to the courts a few times a day, but that is all. The rules are posted, and thus far the players have co-operated admirably in conforming to them.

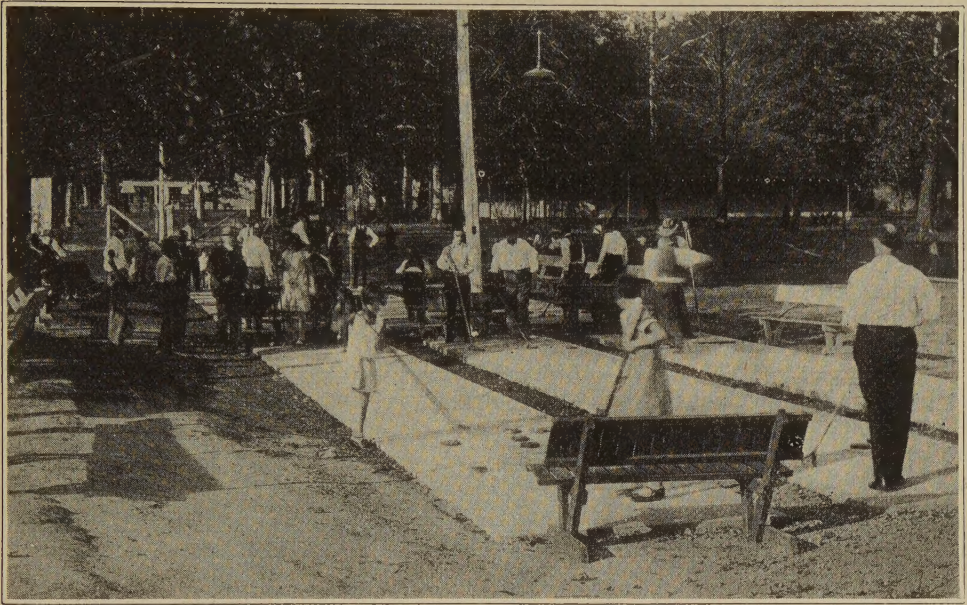


Figure 2. This picture, taken on October 12th, shows that interest in the game had not lagged

Private Courts Relieve Pressure

The pressure on the courts in the park was relieved in a measure by the construction of five indoor courts in space formerly occupied by a skating rink. Here the charge is 5 cents per game per player, making the revenue 20 cents per game for the four players. The time required for playing a game is likely to be anywhere from ten minutes to an hour. The owner of these courts reports satisfactory financial returns from them.

Construction and Cost Data

As one of the illustrations (Figure 1) clearly shows, three courts were built parallel, after which the second three were built end to end with the first three. Each court has 6 or 7 inches of cinders beneath the 5-inch concrete slab, and a tile drain beneath the cinders. Each court measures 6 feet by 43 feet in plan,[1] the dimensions having been obtained from courts at St. Petersburg, Fla.

The contract price for the concrete slabs alone was 16 cents per square foot, bringing the cost of the concrete work to $247.68 for the six courts. The grading, the cinder fill and the tile drains required an additional expenditure of about $100, but this figure can not be given exactly because some of the work was done by the caretaker of the park in the course of his regular duties.

The cost of the equipment is only a minor item, since the only equipment required is four cues and eight discs for each court, or 24 cues and 48 discs for the six courts. This equipment cost only $2.50 per court, or $15 for the six. Benches were built by the park caretaker, or moved to the court from other sections of the park.

From the foregoing it will be seen that the cost did not exceed $65 per court, rather a nominal sum when their recreational value to the community is considered.

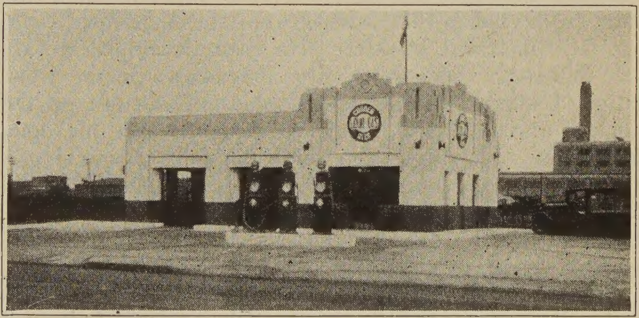
The courts were built by Mervin Stuckman, a local builder of concrete work, who is also the owner as well as the builder of the five private indoor courts previously mentioned. The cues and discs were made by a local manufacturer, the Nappanee Shuffleboard Equipment Company.

Oil Company Builds Distinctive Filling Stations

Concrete Building Units, Cement Stucco and Cast Stone Employed with Appropriate Style of Architecture

The Detroit office of the Cosden Oil Company has adopted a type of construction for its filling stations which, combined with an appropriate architectural style, gives the buildings a distinctive appearance quickly recognized by motorists.

The walls of the buildings are of hollow concrete building units, coated with portland cement stucco. The exterior trimstone is of concrete cast stone. The dark colored base is obtained with a facing of salt-glazed brick.



Plans for this type of filling station had been contemplated for some time by the Detroit office of the oil company, but had been held in abeyance because of adverse rulings of the Detroit city building inspection department. A change in administration in the department resulted in the removal of the restrictions, during September, 1930.

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[1] The dimensions of the courts detailed on page 57 of the March (1930) issue of CONCRETE are 6 ft. by 52 ft.

Spacing Tie Bolts in Forms for Concrete Walls

Relation Between Form Pressure and Depth of Unset Concrete—Experience Given Credit for Small Number of Form Accidents—Safety Indicator Gives Warning if Tie Bolts Are Overstressed

By **D. H. HAYDEN**
President, Wedgit Tie Company, Inc., Brooklyn, N. Y.

THE correct spacing of tie bolts in concrete forms varies with the job and also with the man in charge of the placing of the concrete. It has direct bearing on the quality of the concrete, the alignment and appearance of the finished work, the cost of the forms and the speed of the work.

The most interesting features of form building are the anxiety of some foremen, the over-confidence of others, and the economic waste. Rate of vertical fill of fresh concrete per hour, temperature of the concrete mass, and the experience of the placing foreman, determine the required strength of forms. The amount of intelligent experience has much to do with the cost of making the finished work fit for inspection.

Pressure on Concrete Forms

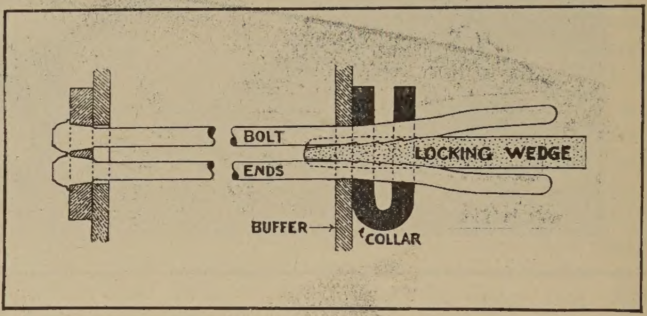
The correct attitude about the spacing of bolts is to be sure that there are enough, because the addition of more bolts means less finishing. The accompanying table is compiled from the records of Major Francis R. Shunk, U. S. A., published in "Professional Memoirs, Corps of Engineers," Volume 1, page 252. The loads given represent the maximum pressures on concrete forms, the pressures being expressed in pounds per square inch. The maximum pressure occurs at the point or time when the concrete arches in the forms, and it has a direct relation to the depth of soft concrete. Rigid forms cause early quiet support, hence quicker arching of the mass and a lower maximum load.

Safe Load Indicator Gives Warning

When the writer realized the full importance of the many requirements for correct form data he stopped sending out illustrated booklets. He then developed a safe load indicator. This safety device is shown in the illustration, U-shaped and takes the place of the nut on the standard threaded bolt. It is so designed that the open end of the "U" stays open until the bolt is carrying a safe load of one ton. If the load is increased beyond that amount, the open end of the "U" will close. The closing of the "U" does not indicate that anything is going to break. It serves primarily as a warning that the tension in the tie bolt has reached the safe working stress. If none of the "U"s close, that is evidence that the tie bolts can be spaced farther apart. If a few of them start to close, that is evidence that the tie bolts are spaced about right for the rate of vertical fill of fresh concrete, and temperature of the mass.

Where the Maximum Pressures Occur

There is more or less experimenting going on among users of these tie bolts to determine the most efficient way to bolt form work. The results show that during rapid placing of concrete the greatest load on wall forms occurs at from 2 to 4 ft. from the bottom and that at about 8 ft. from the bottom the load is not much more than half as much. If the placing of concrete is carried on evenly and level, the form load stays about constant from the 8-ft. level to within about 6 ft. of the top, when it diminishes very rapidly. The spacing of the walers should be about 1½ to 2 times the spacing of the bolts. These observations have been gathered from the tying of many walls varying from 15 to 30 ft. in height, which were concreted in 8 hours.



The U-shaped collar closes when the tension on the tie bolts exceeds the safe load

Pressure on Concrete Forms, Expressed in Lb. Per Sq. In.

Vertical fill of concrete per hour	Temperature of Concrete Mass 80 deg.	70 deg.	60 deg.	50 deg.	40 deg.
2 feet	530	560	600	680	790
3 feet	690	720	810	920	1080
4 feet	820	870	980	1130	1340
5 feet	930	990	1120	1310	1570
6 feet	1020	1090	1250	1480	1780
7 feet	1090	1170	1350	1620	1970
8 feet	1130	1240	1440	1740	———

Field Data Obtained

In order to get the correct field data, the writer took a sub-contract for and built about 200,000 sq. ft. of forms for varying thicknesses of walls. The construction was for multi-story walls of a very "cut up" design, but fortunately the building was of a design which is duplicated many times, so that a rather dependable unit cost for the form work was obtainable.

Organizations

American Concrete Institute; Harvey Whipple, Secretary, 2970 West Grand Blvd., Detroit, Michigan.
Annual convention, February 24-26, Hotel Schroeder, Milwaukee, Wis.

American Concrete Pipe Association; M. W. Loving, Secretary, 33 W. Grand Ave., Chicago.

American Road Builders' Association; Chas. Upham, Engineer-Director, 914 National Press Building, Washington, D. C.

American Society of Civil Engineers; Geo. T. Seabury, Secretary, 33 W. Thirty-ninth St., New York City.

American Society for Testing Materials; C. L. Warwick, Secretary-Treasurer, 1315 Spruce St., Philadelphia, Pa.

Associated General Contractors of America; E. J. Harding, Assistant General Manager, 1150 Munsey Bldg., Washington, D. C.

Cast Stone Institute; L. A. Falco, Secretary, Chapel St. and Blatchley Ave., New Haven, Conn.

Building Officials Conference of America; Col. John W. Oehmann, Secretary, 1253 Lawrence St., N. E., Washington, D. C.

Cement Institute; Luther G. McConnell, General Manager, 11 East 44th St., New York City.

Concrete Masonry Association; Jack Franklin, Secretary, 7071 Plankinton Bldg., Milwaukee, Wisconsin.
Annual convention, February 23-26, Hotel Schroeder, Milwaukee, Wis.

Concrete Reinforcing Steel Institute; M. A. Beeman, Secretary, Tribune Tower, Chicago.

Haydite Manufacturers' Association; Dan F. Servey, Secretary-Treasurer, 203 Mutual Building, Kansas City, Mo.

Joint Committee on Standard Specifications for Concrete and Reinforced Concrete; F. R. McMillan, Secretary, 33 W. Grand Ave., Chicago.

National Association of Paris Transit Mixed Concrete Manufacturers; Chas. P. Maloney, Secretary, E. Water and E. Salmon Streets, Portland, Oregon.

National Board of Fire Underwriters; W. E. Mallalieu, General Manager, 85 John St., New York City.

National Concrete Burial Vault Association; J. H. Stuart, Secretary-Treasurer, Bremen, Ohio.

National Crushed Stone Association; J. R. Boyd, Secretary, 751 Earle Building, Washington, D. C.
Fourteenth annual convention, January 19-22, St. Louis, Mo.

National Fire Protection Association; Franklin H. Wentworth, Secretary, 40 Central St., Boston, Mass.

National Lime Association; Norman G. Hough, Secretary and Manager, 927 Fifteenth St., N. W., Washington, D. C.

National Ready-Mixed Concrete Association; Headquarters, 27 Barbeau Street, Pittsburgh, Pa.

National Sand and Gravel Association; V. P. Ahearn, Executive Secretary, 432 Munsey Building, Washington, D. C.

National Slag Association; H. J. Love, Secretary-Treasurer, 937 Leader Building, Cleveland, Ohio.

Northwest Concrete Products Association; W. P. Hews, Secretary-Treasurer, Yakima, Wash.

Portland Cement Association; William M. Kinney, General Manager, 33 W. Grand Ave., Chicago.

Rail Steel Bar Association; H. P. Bigler, Engineering Secretary, Builders' Building, 228 N. La Salle St., Chicago, Ill.

Wisconsin Concrete Products Association; Jack Franklin, Secretary-Treasurer, 425 East Water St., Milwaukee, Wisconsin.
Annual convention, February 23-26, Hotel Schroeder, Milwaukee.

The Concrete Industry
—25 YEARS AGO

HARRY D. GUE, in the leading article in the November, 1905, issue of CONCRETE, tells about "A Reinforced Concrete Paper Warehouse." In the space of 4 pages he points out the distinguishing features of such buildings as a class and then describes the design, construction details and the contractor's plant of the Robert Gair structure at Brooklyn.

* * *

REPORT is made of the progress of the 9-month-old organization known as the National Association of Cement Users (the present-day American Concrete Institute).

Plans for the first annual convention are announced, with Milwaukee, Wisconsin, as the selected city. Among those scheduled to take part in the program are "Mr. J. P. Scherer, who for a number of years has been a large manager of concrete products at Milwaukee, will present a paper upon Air Tamping of Concrete Blocks and the Conveying of Blocks. Mr. E. S. Larned, C.E., connected with the Boston office of the American Cement Co., will discuss the Testing and Uses of Natural and Portland Cements. Building Regulations Regarding Concrete Blocks is the subject assigned to Mr. W. J. Scoutt of Chicago."

* * *

THE November, 1905, issue of *Cement Age* contains the paper selected for third place in a competition conducted by that journal and another on the manufacture and use of block.

In this paper H. G. Richey tells, who, in his opinion, is qualified to engage in their manufacture. He gives a list of don'ts; some of them are: Don't make blocks in a freezing atmosphere; don't try to make clean, sharp blocks with dirty or rusty molds; don't try to trowel or work cement after it has acquired its initial set.

* * *

THREE displays, shown at a German cement exposition and made with true white hydraulic cement, are shown as part of a short article. The stone is called Marbrit because of its resemblance to white marble. The molds used are not mentioned, but the stone "can be worked shortly after setting, either with the chisel or other implement." Pedestals, capitals, fountains and the cherubic statues of the period are included.

* * *

THE construction of grain tanks for the Quaker City Flour Mills Company, Philadelphia, is described. Illustrations show the sliding form work used and their handling is described as follows: "The forms are lined with galvanized iron and are hoisted by a jacking device attached by stirrups to upright timbers, which serve as guides. A hanging scaffold inside the form supports the workmen when engaged in hoisting them.

"At intervals of 12 inches the tanks are reinforced with iron bands $\frac{1}{4}$ and $1\frac{1}{4}$ in. to the height of about 60 ft. and above that 3/16 by $1\frac{1}{8}$ in. iron will be used. It was intended to reinforce to the height of 40 feet with the larger iron, but there is sufficient to reach 60 ft. and it will be used. In addition to the reinforcement described, $\frac{1}{2}$ in. rods three feet apart extend from the bottom to the top of the tanks."

About Makers of Equipment and Materials

Notes From the Field

Portland Machines Moves

Portland Concrete Machines Company, formerly of Chicago, has moved its headquarters to Cleveland and is now located at 4519 Hamilton Avenue, N. E. Clarence B. Dutton is president.

The company sponsors a complete line of machinery for ready-mixed concrete plants, including elevators, bins, batchers, stationary mixers, truck mixers, and all other incidental equipment; as well as automatic machinery for producing block, tile and other concrete products at rates up to nine full-sized units per minute. It also conducts an engineering and consulting service for the design and equipment of complete ready-mix and products plants, and the preparation of operating schedules and budgets.

The heads of the company have had years of experience in all branches of the concrete products and concrete machinery business, and the equipment now being offered includes radically new improvements making the machinery distinctive in performance and appearance, an announcement states. Design and testing have been in progress in the Cleveland plant of Industrial Brownhoist Corporation for more than a year; a substantial stock of machinery is carried for immediate shipment and with intensive marketing actively under way it has been decided to locate executive offices at the manufacturing plant where more effective co-operation can be maintained between sales and manufacturing staffs.

Concrete Brick More in Demand

The demand for concrete brick has quite materially increased during the past summer, according to Frank R. Oakes, vice-president of the Besser Manufacturing Company, Alpena, Michigan.

Early last spring an attachment for making concrete brick, six at a time, was introduced by the Besser Manufacturing Co. for use on their stripper machines. The demand for this attachment has far exceeded expectations when it was first placed on the market. Many of these attachments have been in use all during the spring and summer of this year in various sections of the country, it is said.

Mr. Oakes states that this brick attachment is simple and exceedingly speedy. On the Besser standard stripper 36 concrete brick per minute can be made, according to Mr. Oakes. Six brick are made at a time on a plain pallet, the same as is used for all units on Besser strippers. No special pallets are needed. The Super stripper makes these brick at the rate of 48 per minute. The brick are uniform, standard size, troweled on four sides.

S. H. Wightman Dies

Sherburne H. Wightman, vice-president and chief engineer of the *Portland Concrete Machines Company,* Chicago, died suddenly October 2nd at his home at Hammond, Indiana, following an operation for appendicitis.

Mr. Wightman had had broad experience in industrial and engineering operations. He was at one time vice-president and general manager of the Delta Brick and Tile Company, and later, general manager of the Eberling Machine Company. Subsequently Mr. Wightman served in the capacity of vice-president and treasurer of the Besser Sales Company.

Mr. Wightman was born in Marysville, Calif., in 1882, and received his engineering training at Swarthmore College, Swarthmore, Pa.

Chain Belt Distributors

Chain Belt Company of Milwaukee announce the appointment of two new distributors, namely: the *Alabama Machinery & Supply Company* of Montgomery, Alabama, and the *Concrete Products Sales Company, Ltd.,* of Oakland, California.

Industrial Literature

Sika Publications

Several publications—two 8-page printed booklets and a multigraphed folder—have been published recently on the subject of *Sika,* a compound that "waterproofs unconditionally."

Its resistance to magnesium sulphate is the subject of one leaflet, while Sika's successful waterproofing under pressures due to heads of water of 500 ft. and upward is dealt with in the second. Test results are given in the third leaflet. All are published by the *American Sika Corporation,* New York City.

Bentonite Booklet

The properties, sources, geology and production of *Bentonite* are described in *Bulletin* 107, published recently by the *Silica Products Company,* Kansas City, Mo.

Its properties are defined at length, and each successive phase from its geology on is described. Illustrations are shown profusely.

Alpha Handbook

A revised, seventh, edition of the *Alpha Portland Cement Company* handbook, "*Alpha Cement—How to Use It,*" has just been issued and is now being distributed.

The handbook contains building instructions on numerous concrete improvements and structures, tables to be used in figuring quantities of materials necessary for different types of work, as well as articles on high early strength concrete, cement stucco, watertight concrete, and concreting in cold weather.

The book has 112 pages and contains profuse illustrations.

Products Plant Mixers

A mixer catalog just issued and now being distributed by the *Besser Manufacturing Company,* Alpena, Mich., is that on batch mixers "for concrete products plants in all the Standard Capacities."

This is an 8-page publication comprising illustrations depicting the various features of this type of equipment and describing their quality.

"Economical Material Handling"

A profusely illustrated book which pictures many interesting installations of conveying equipment has just been published under the title of "*Economical Material Handling,*" by the *Louden Machinery Co.,* Fairfield, Iowa.

The publication analyzes the problems of material handling and discusses the solution of correct methods and equipment.

Light-Weight Aggregates

What is happening in the use of concrete masonry units is the subject of a 2-page letter addressed to products manufacturers by the *H. H. Potts Company,* Chicago.

It is pointed out that there has been a decrease in the production of ordinary heavy-weight building units and a large increase in the use of light-weight units used above grade for back-up work. Past three years' figures are given.

Lapidensin Broadside

A six-page broadside recently published by the *American Fluresit Company,* Cincinnati, Ohio, is devoted to the protective coating known as *Lapidensin,* introduced into America a few years ago.

The origin of the preservative is described, and American structures on which it has been applied are pictured.